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(U) The objective of the Aircrew Gliding Escape System (AGES) Program is to develop a ram-air-inflated, gliding parachute wing for use in Navy aircrew escape systems. This report describes an in-flight ejection test conducted at the Naval Weapons Center on 23 October 1984 using the AGES parachute canopy in a Stencel SIIIS-3-ER ejection seat. The test was initiated at 500 knots equivalent airspeed (KEAS) at 5000 feet AGL (7500 feet MSL) from the rear seat of the Center's YF-4 aircraft. The riser loads on the dummy were well within acceptable limits, and no damage occurred to the parachute or the seat system (which was recovered by a separate parachute).

(U) This report contains complete documentation of the test setup for the seat and parachute. In addition, copies of the test plan, abort criteria, and checklists are included.

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In-Flight Ejection Seat Test Using the Aircrew Gliding Escape System (AGES) Parachute

by
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SEPTEMBER 1986

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Naval Weapons Center

FOREWORD

The test described in this report was conducted at the Naval Weapons Center, China Lake, CA, in October, 1984, under the Aircrew Gliding Escape System (AGES) Program.

This report was reviewed for technical accuracy by Russ Bates and LCdr. Larry Schoenberg.

Approved by
C. V. BRYAN, *Head*
Aerosystems Department
16 September 1986

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The author would especially like to thank Russ Sanford, formerly of the Aerosystems Department Program Office, for his help and effort in successfully ram-rodding this entire test program from start to finish.

INTRODUCTION

The objective of the Aircrew Gliding Escape System (AGES) Program is to develop a ram-air-inflated, gliding parachute wing for use in Navy aircrew escape systems that will provide the following advantages over the currently available parachute canopies:

1. Lower rate-of-descent and lower impact energy
2. Lower opening forces at high speed while reducing the opening times at low speeds
3. Enhanced manueverability and evasion capabilities

This report is part of the documentation of work conducted during fiscal years 1984 and 1985. Reference 1 is a summary of the work conducted on the AGES Program from fiscal years 1977 through 1983. Additional related information can be found in References 2 through 5.

This test was conducted at the Naval Weapons Center on 23 October 1984 to prove the feasibility of adapting this class of parachute canopy to the ejection environment and was the first-ever use of a ram-air-inflated, gliding parachute wing in an ejection seat.

Readers who are not familiar with ram-air-inflated, gliding parachute wings should review Reference 4 to familiarize themselves with the basic concepts and nomenclature.

TEST ITEMS

PARACHUTE

The test parachute was an AGES canopy (Configuration 13A) installed on the standard risers used in the Stencel seat. The basic canopy parameters are seven cells, spanwise construction, Lissaman 7808 airfoil, aspect ratio of 2.0, surface area of 270 square feet, 32 suspension lines and eight brake/steering lines, and lines-first deployment using a free deployment bag. Appendix A contains the packing instructions and several photographs with details of the parachute canopy. A description of the reefing system used can be found in Reference 1. Additional details of the parachute canopy can be found in Reference 5. A deployment bag was fabricated by the project engineer to fit the dimensions and profile of the SIIIS-3 headbox and to provide an attachment to the drogue bridle. The headbox itself was slightly modified by the removal of a cloth-covered sheet-metal bracket that is normally used inside the headbox.

EJECTION SEAT

The seat used was a Stencel Aero Engineering Model SIIIS-3-ER, which is fully qualified for use in the A-7 and TA-7 aircraft. For this test, the seat was modified with the addition of yaw stabilization vanes that are intended to limit seat yaw before the drogue parachute becomes effective. All other components of the seat system were standard equipment as used on the production SIIIS-3-ER seat. The WORD (wind-oriented rocket-device) motor, although installed, was inert, and the seat sequencer was locked in the high-speed mode. A complete description of the functional sequence of the seat can be found in the Stencel test plan that is contained in Appendix B. Figures 1 and 2 show the seat mounted in the fixture used to determine the center-of-gravity of the entire test item before installation in the aircraft. Figure 3 shows the seat-mounting adapter plate fastened to the bulkhead in the aft cockpit of the YF-4 aircraft before seat installation.

TEST RESULTS

The test was initiated at 500 knots equivalent airspeed (KEAS) at 5000 feet AGL (7500 feet MSL) from the rear seat of the Center's YF-4 aircraft, which is specially equipped for intentional, in-flight ejections. Videotape and motion picture camera coverage shows that the ejection seat and dummy combination exited the rear cockpit of the test air-craft cleanly and in a stable attitude. Deployment of the drogue appeared to be normal and was very effective in maintaining system stability. Although the yaw stabilization vanes were initially deployed as the seat left the aircraft, they did not lock in the extended position. Later, as the deceleration forces from the drogue parachute were applied to the seat, the vanes rapidly folded back into the stowed position against the seat and remained there throughout the rest of the test.

Deployment of the AGES canopy was normal and the reefing system performed as designed, i.e., the first-stage reefing released the leading edge of the canopy at approximately 0.7 second and the second-stage reefing released the slider and lower surface of the canopy at approximately 1.4 seconds after initiation. On this test, both reefing stages were initiated by the same 24-inch lanyard (attached to the headbox) that pulled the cutter firing pins just after the deployment bag was extracted from the headbox.

Figures 4 through 19 show the ejection sequence from just after initiation until both canopies are open and stable. The flashes in Figures 8 and 9 indicate drogue release from the seat and the beginning of seat/man separation, respectively. These photographs were taken from the 35-mm event camera and are the best still coverage available. Unfortunately, the chase aircraft was not in the proper position during the ejection and no air-to-air photographic coverage was obtained from the chase aircraft. In addition, the cameras installed in the cockpit produced no useable film.

The opening forces from the test parachute were very low (approximately 1400 pounds total) due to the low weight of the dummy and his equipment (155 pounds) and the relatively long reefing system time delays (0.7 and 1.4 second) used for this test. The time delays were selected because they were the shortest time delays that had previously been tested using this reefing system configuration; the use of a fifth-percentile test dummy was directed by higher authority. It is obvious, in retrospect, that much shorter time delays on the reefing system can be used in conjunction with this seat system.

A collision occurred between the AGES canopy and the 24-foot seat recovery parachute immediately after the second stage disreefed on the AGES canopy. However, no entanglement occurred and neither canopy was damaged. This collision caused some perturbations in the opening sequence of the AGES canopy, so the event times listed in Appendix C are not typical of what can be expected during a normal deployment of the AGES canopy. In addition to the test data in Appendix C, a videotape of the test can be obtained from the Aerosystems Department, Program Support Branch (Code 6413).

The AGES canopy appeared to be either stalled, or on the verge of stalling, throughout the descent because of the low forward velocity resulting from the very light suspended weight. This condition contributed to the unusually high descent rate measured. The 150-pound dummy used was (by far) the lightest load tested on the current configuration of the AGES canopy. Consequently, with no relevant test data to use as guidance, the deployment brake setting had to be estimated based on tests with heavier loads. A simple adjustment of the deployment setting by 2 to 3 inches will ensure that the canopy will fly with a safe margin above stall even at very light payloads. Even though the deployment brakes were not set correctly, the dummy appeared to have a very soft touchdown and was facing approximately upwind at the time of ground impact.

POST-TEST INSPECTION

An inspection of the test items after the test revealed no damage to any part of the ejection seat itself and no damage to the AGES canopy. However, the drogue bridle revealed several cuts (Figure 20) which appear to have been caused by a shackle that is also used in the bridle. In addition, three of eight suspension lines on the drogue canopy itself were severed (Figure 21). It has not been determined exactly how the damage to the lines occurred; however, it should be noted that the drogue and deployment bag assembly were not recovered from the drop zone until approximately 30 days after the test date.

Figures 22 and 23, respectively, show the attitude of the test dummy and canopy after landing. Note that the dummy's arms were tied to his chest in order to minimize flailing during the first moments of the ejection.

The deployment bag itself showed no damage to any of the structure nor to the neoprene O-rings used to stow the lines and lock the flaps on the deployment bag. Figure 24 shows one lower edge of the deployment bag and illustrates the placement of the O-rings. Figure 25 shows the overall layout of the drogue parachute, deployment bag, and related components.

CONCLUSIONS

The major technical obstacles to the use of a ram-air inflated gliding parachute wing in modern escape system have been overcome and demonstrated by this test. The most important tasks awaiting completion, as of this writing (19 July 86), are an accurate determination of the physiological conditions during parachute landings (see References 2 and 3) and the detail design of a parachute to meet the required parameters for vertical and horizontal velocity.

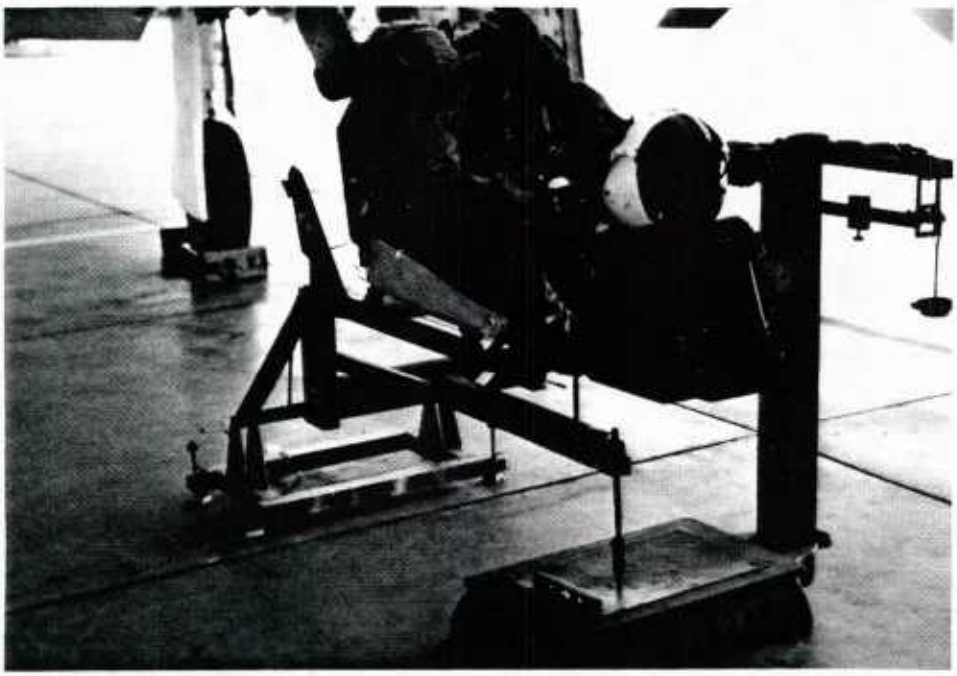

FIGURE 1. Seat and Dummy Mounted in Device for Center-of-Gravity Measurement (Lateral View).

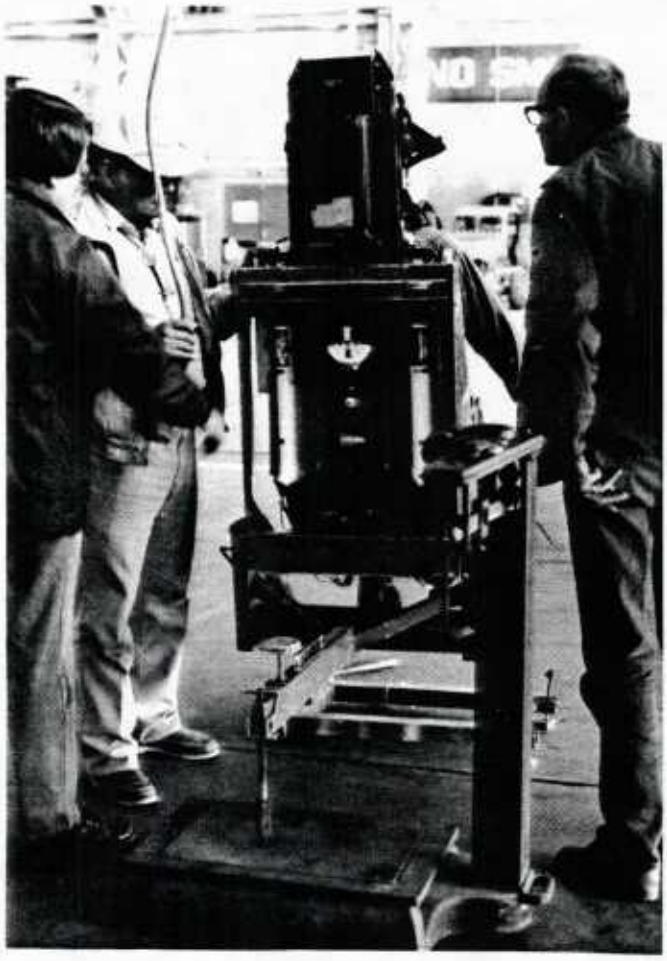

FIGURE 2. Seat and Dummy Mounted in Device for Center-of-Gravity Measurement (Rear View).

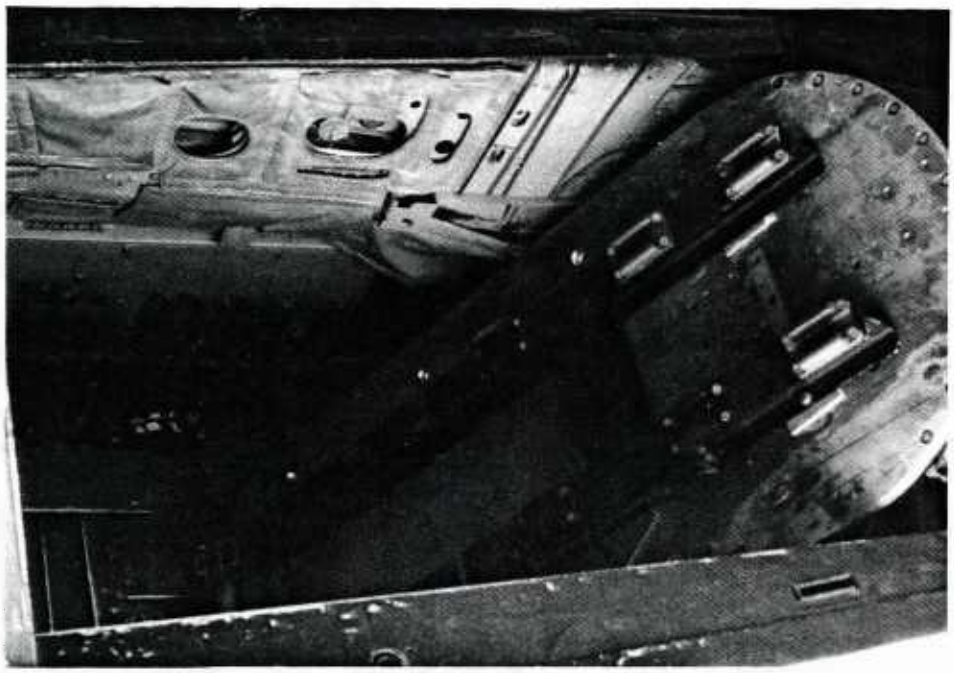

FIGURE 3. Seat-Mounting Adapter Plate Fastened to Rear Bulkhead, Aft Cockpit, of the YF-4 Aircraft. Brackets shown are guides for the SIIIS-3 seat rails.

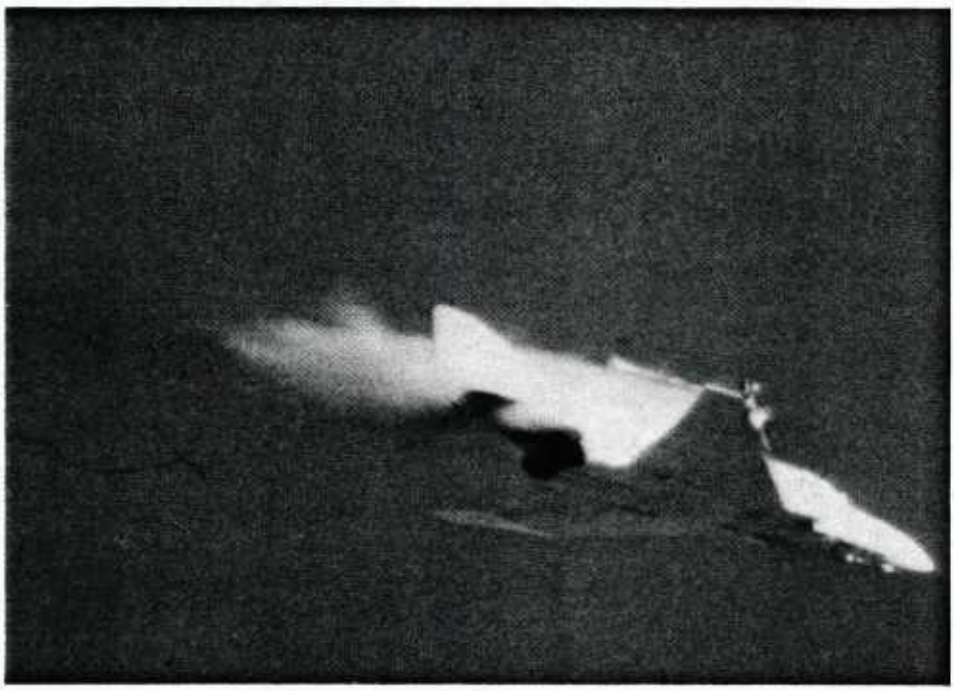

FIGURE 4. Ejection Sequence Showing Seat Just After Exit From Cockpit. Note that the drogue has extended and has begun to inflate.

FIGURE 5. Drogue is Hidden In Exhaust Plume From Seat Back Rockets.

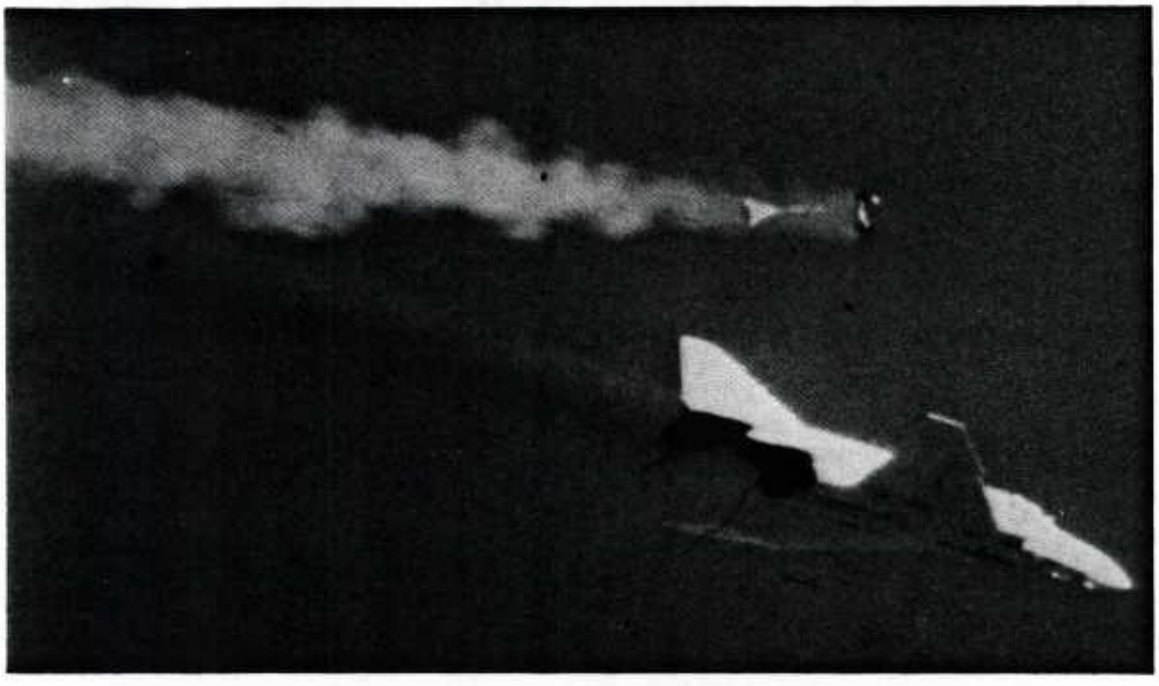

FIGURE 6. Seat Back Rockets Have Burned Out. Note stable attitude of seat.

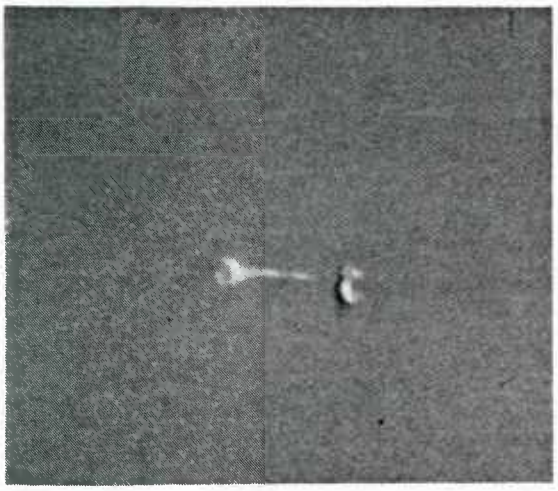

FIGURE 7. Drogue is Decelerating Seat/Man Combination.

FIGURE 8. Flashbulb Indicates That Drogue Release Mechanism Has Fired.

FIGURE 9. Canopy Has Reached Line Stretch and Deployment Bag Has Just Stripped Off. Flashbulb at seat indicates that seat/man separation mechanism has just fired.

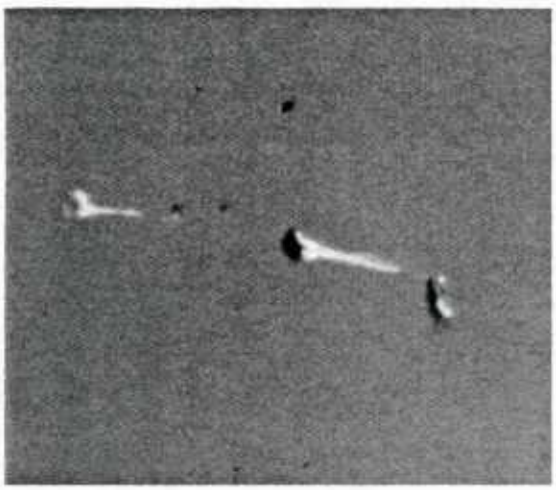

FIGURE 10. Drogue is Completely Clear of Parachute. AGES parachute is beginning to inflate. Note that the seat/man combination has a very stable attitude.

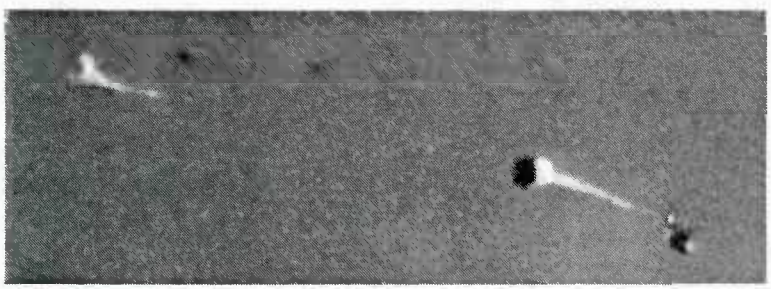

FIGURE 11. AGES First-Stage Reefing Activated and Drag From the AGES Parachute is Increasing Causing the Man to Begin to Pull Away From the Seat.

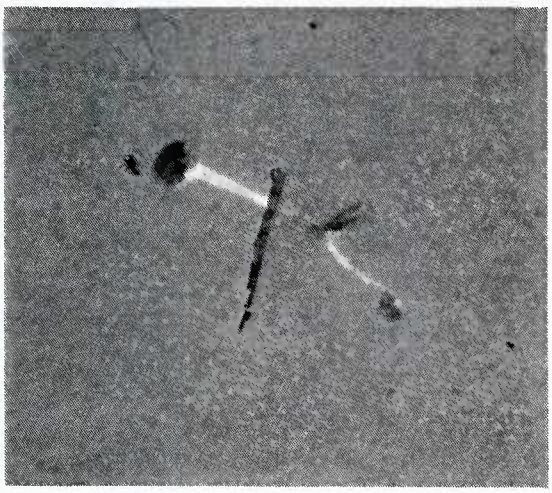

FIGURE 12. Seat/Man Separation Complete. Note that the seat recovery parachute (not normally installed) is deploying from a pack attached to the dummy's seat pan.

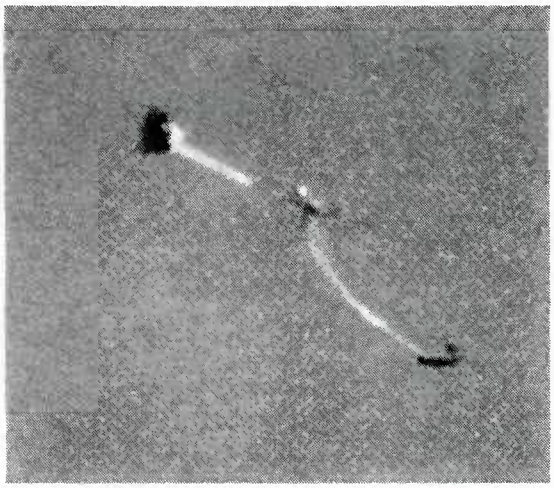

FIGURE 13. Seat Recovery Parachute Is Almost At Line Stretch. Note slight line sail on seat recovery parachute.

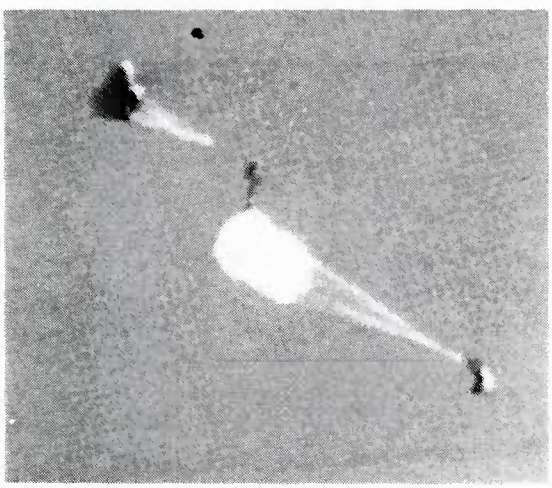

FIGURE 14. AGES Parachute Second Stage Reefing Has Activated. Seat recovery parachute is beginning to fill.

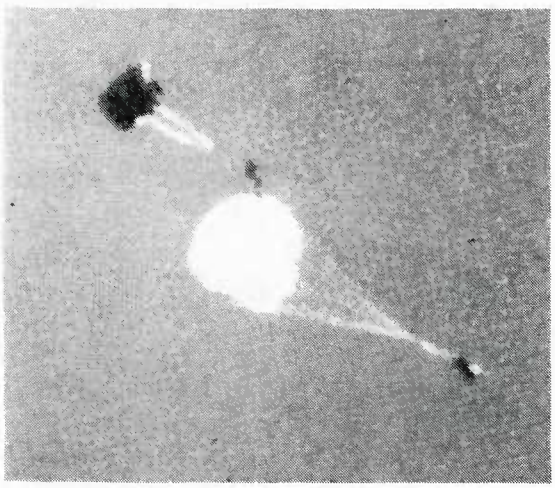

FIGURE 15. AGES Parachute Opening Further. Seat recovery parachute and dummy are very close at this point.

FIGURE 16. AGES Parachute Almost Fully Open. Seat recovery parachute is over inflated in this frame.

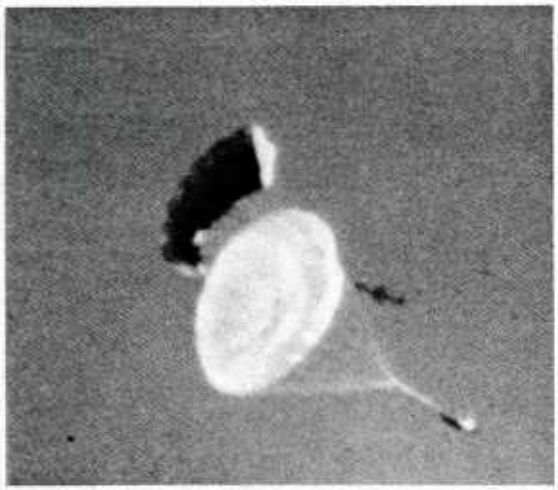

FIGURE 17. Upper Area of Suspension Lines on the AGES Canopy Has Contacted the Seat Recovery Parachute. Note that the AGES canopy is offset to the side enough to prevent the dummy from entangling in the lines of the seat recovery parachute.

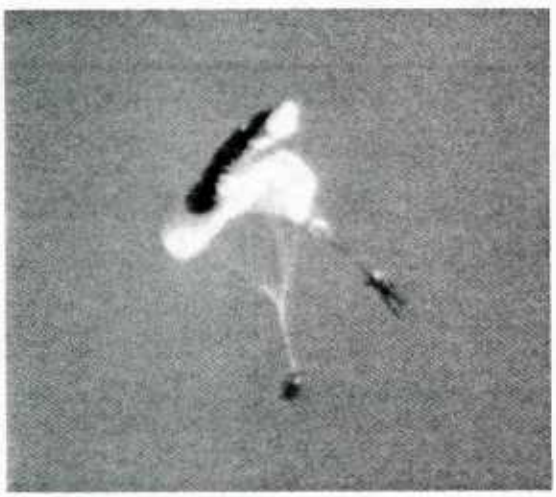

FIGURE 18. Parachutes Have Separated and Are Beginning to Stabilize.

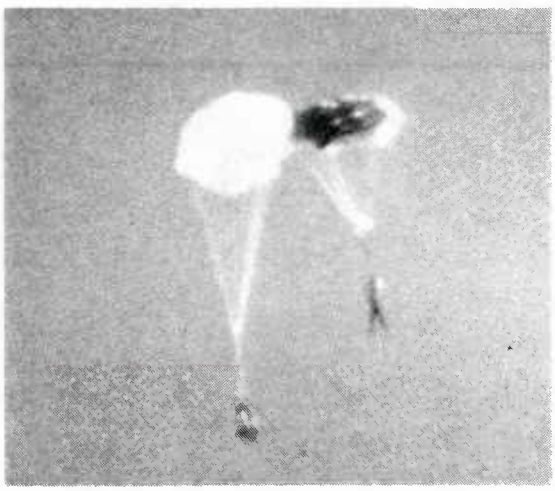

FIGURE 19. Canopies Separate and Stable.

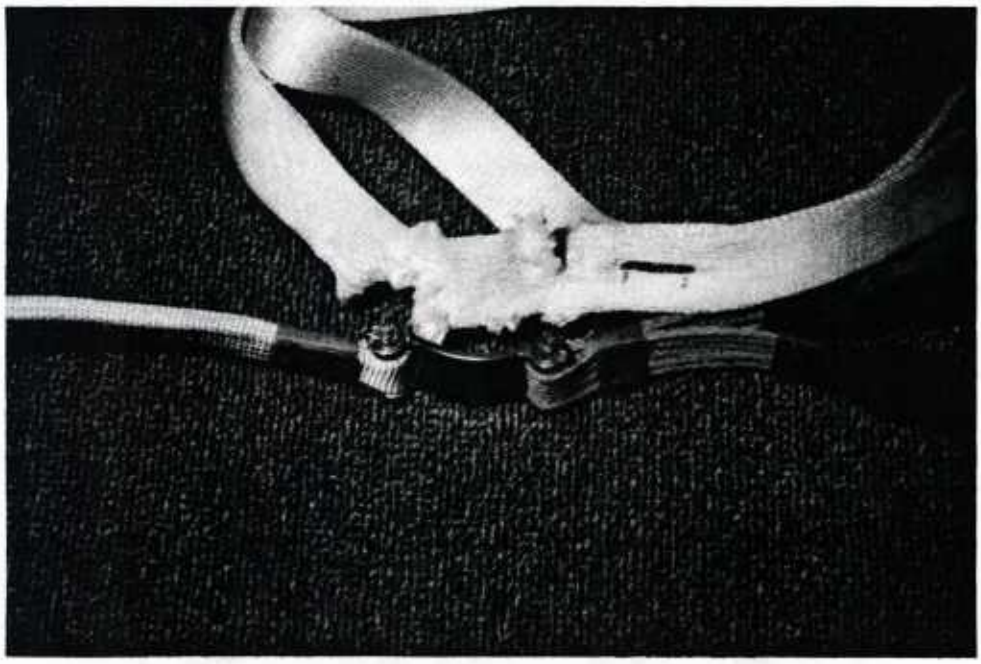

FIGURE 20. Drogue Bridle Showing Cuts Possibly Caused By Shackle.

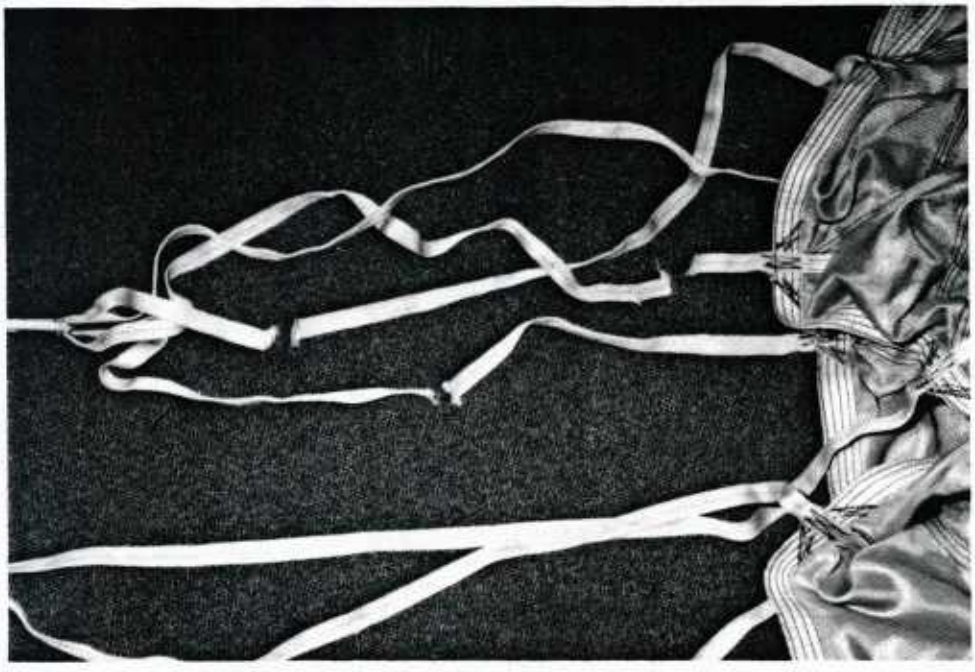

FIGURE 21. Severed Lines on Drogue Canopy.

FIGURE 22. Test Dummy After Landing.

FIGURE 23. Test Canopy After Landing.

FIGURE 24. Lower Edge of Deployment Bag Showing O-rings Used to Stow Suspension Lines.

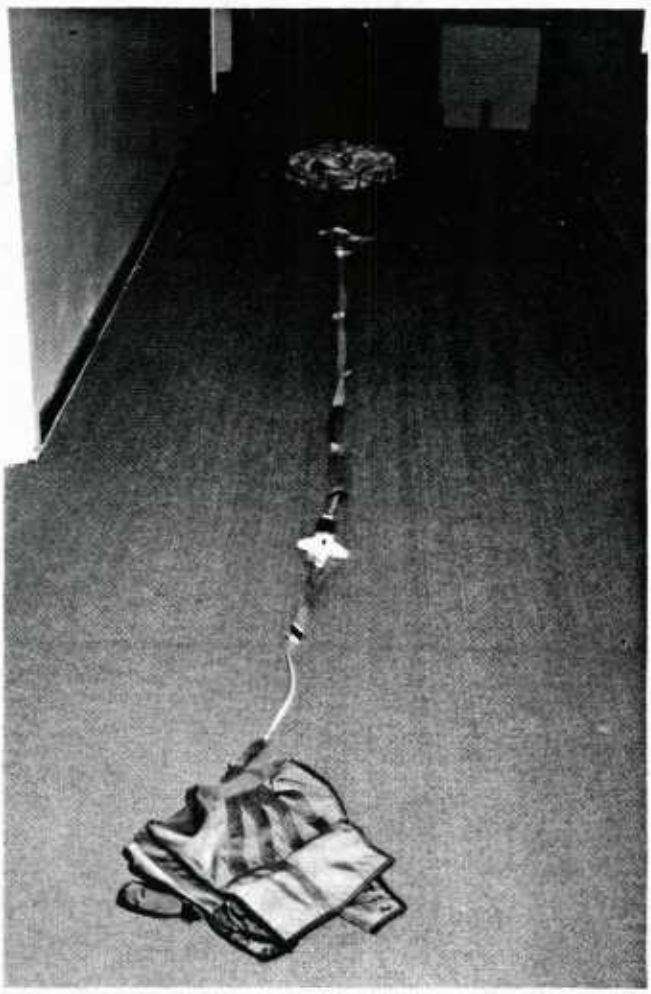

FIGURE 25. Overall Layout of the Drogue Parachute, Deployment Bag, and Related Components.

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Appendix A
AGES TWO-STAGE REEFING
PACKING INSTRUCTIONS

NOTE: These instructions assume that the parachute rigger is intimately familiar with this class of parachute. Packing requires 2 each F1-0.7 and F1-1.4 reefing line cutters.

1. Lay risers and suspension lines face down, head toward canopy. Lay canopy left side down with cell openings to right as viewed from the risers. Pull the suspension lines taut. Figure A-1.

   a. Check riser orientation—face down with no twists.
   b. Check riser release system for proper assembly and function.
   c. Check line continuity:
      (1) Lines A and B of Sets 1 to 4 go to the left front riser.
      (2) Lines C and D of Sets 1 to 4 go to the left rear riser.
      (3) Lines A and B of Sets 5 to 8 go to the right front riser.
      (4) Lines C and D of Sets 5 to 8 go to the right rear riser.
      (5) Steering and brake lines go through guide rings on the back of the rear risers on both sides.

2. Starting at the leading edge (using the high points on each cell), flake the canopy and lay flat on the left side.

3. Set the deployment brakes at 12 inches above the bottom of the leading edge by looping the end of the lower control line around the center of the rear connector link on the corresponding side and finger trapping the line back into itself. Hand tack the finger trap with two turns of waxed 6-cord cotton or equivalent.

4. Using the ring attached to the center of the slider, pull the slider up to the slider stops (on the lower edge of the stabilizers). Be sure that the slider is not twisted or inverted.

5. Second-stage reefing line routing. Use MIL-C-7515, Type 2 suspension line for the second stage reefing line. Leaving a minimum of 12 extra inches on each end, measure and a 45-inch section for the reefing line. Mark the center of the 45-inch section.

   a. Thread both second stage cutters (1.4 second) onto one end of the reefing line and tie a knot in the end of the line to keep the cutters from falling off. Pull the loose end of the reefing line through all eight rings on the line attachments at the leading edge using a wire bodkin as shown in Figure A-2. Note that the reefing line must pass behind the suspension lines on the leading edge to avoid burning the suspension lines or reefing line.

b. Starting at the right-most ring on the leading edge (will be on top of the canopy at line no. 8A), the reefing line is passed rearward along the inside of the right stabilizer. There are rings on lines 8B, 8C, and 8D slightly above the bottom edge of the stabilizer. Between the rings on 8B and 8C, the line must pass through the ring on the center of the slider.

c. After passing through the ring on line 8D, begin routing the reefing line through all the rings on the trailing edge from the right rear across the the trailing edge toward the left rear.

d. Next, proceed forward along the inside of the left stabilizer through the rings on 1D and 1C. Pass through the slider ring between 1C and 1B; avoid trapping any suspension lines against the stabilizer with the reefing line. After passing through the ring at 1B, temporarily tie the ends of the reefing line together.

* * DO NOT REMOVE THE SAFETY PINS AT THIS TIME * *
* * CHECK THE REEFING LINE ROUTING TO ENSURE THAT ALL * *
* * RINGS HAVE BEEN THREADED IN THE PROPER ORDER * *

6. First-stage reefing line routing. Cut a 3-foot section of MIL-C-7515, Type 2, suspension line.

NOTE: The first-stage reefing line is a very short loop that controls the inflation of the leading edge by holding the upper surface of the canopy (at the leading edge) down against the lower surface of the canopy (at the leading edge) using reefing rings installed on the upper leading edge at the intersection of each non- loaded rib and reefing rings installed on the lower leading edge at the line attachment tapes (same rings used for second-stage reefing). There are a total of 15 rings on the leading edge—eight on the suspension line attachment points and one each (seven total) on the top of each non-loaded rib at the leading edge. The reefing line must pass behind the suspension lines on the leading edge to avoid burning the suspension lines or reefing line.

a. Thread the wire bodkin through the leading edge rings starting with the ring at 8A, then the upper ring on cell 7, the ring at 7A, the upper ring on cell 6, and so on. After threading the line across the leading edge, bring the end on the right side back across to the end on the left side (go behind the suspension line). Thread the reefing line through both first-stage cutters and temporarily tie the ends together.

* * DO NOT REMOVE THE SAFETY PINS AT THIS TIME * *

b. Draw the first-stage reefing line as tight as possible, then tie the ends using a bloodknot with the ends finger trapped inside the line to prevent snagging. Cut off the excess line. Figure A-3 shows the first-stage reefing line loop immediately after this step.

7. Untie the temporary knot in the second-stage reefing line, then join the ends using a double finger trap drawn up to the 45-inch mark. Hand tack the center of the finger trap with two turns of 6-cord. Slide the reefing line through the cutters until the mark in the center of the line is between the cutters; this should place the finger trap in the center of the trailing edge. Snug the cutters up against each other, then tape all of the cutters together using fiberglass tape; leave at least 0.5-inch clearance between the edge of the tape and the reefing line and leave room to remove the safety pins later.

8. Pull all suspension lines tight, fold the leading edge back toward the A lines, then S-fold the canopy in three sections placing all the suspension lines on top of each other. Keep all the lines tight. Clear the stabilizers on both sides (three panels on each side).

9. Flake and split the trailing edge in the center. All chordwise seams near the trailing edge will lay along the center of the stacked canopy in line with the suspension lines. Keep all the suspension lines tight below the slider. Fold the stacked trailing edge around the canopy and press all the air out of the canopy.

10. Draw the second-stage reefing line tight; then loosely S-fold the excess reefing line and stow it in a rubber band in any suitable location near the normal routing of the reefing line (exact location is not critical as long as the line can flow freely when the canopy begins to spread).

11. Draw the slider up tight against the slider stops, then fold the stabilizers around the top of the slider.

12. Place the deployment bag in the packing fixture and hold the flaps back so that the canopy can be inserted into the bag.

13. S-fold the canopy into the bag so that the slider (and suspension line attachments) are last in.

14. Locate the cutters and pull them up so that the firing pins can be passed through the grommets on the bag. Note that you may have to slightly distort the rings on the end of the firing pins in order for the ring to pass through the no. 0 grommets. Route the firing lanyard through all of the cutter firing pins and tie off with a locking bowline knot. Figure A-4 shows the relationship between the cutter firing pin and ring, the firing lanyard, and the grommet in the end flap of the deployment bag.

* * REMOVE THE SAFETY PINS FROM THE CUTTERS * *

15. Carefully (to avoid accidentally firing the cutters) fold the closing/locking flaps of the bag over and thread all the O-rings through the matching grommets. The suspension lines will emerge from the center between the two flaps.

16. Begin stowing the lines at one end and proceed to the other end. Each stow should extend beyond the O-ring approximately 1 inch. Leave approximately 1 foot of lines unstowed. Fold the line cover flap into place and fasten the velcro

17. Dress the bag, orient it in the proper relationship to the headbox, then insert into the headbox container.

18. Finish packing according to the normal instructions for the SIIIS-3-ER parachute system.

FIGURE A-1. Canopy Laid Out Before Packing Showing Correct Orientation of Canopy, Suspension Lines, and Risers.

FIGURE A-2. Wire Bodkin Used to Pull Reefing Line Through Rings on the Leading Edge.

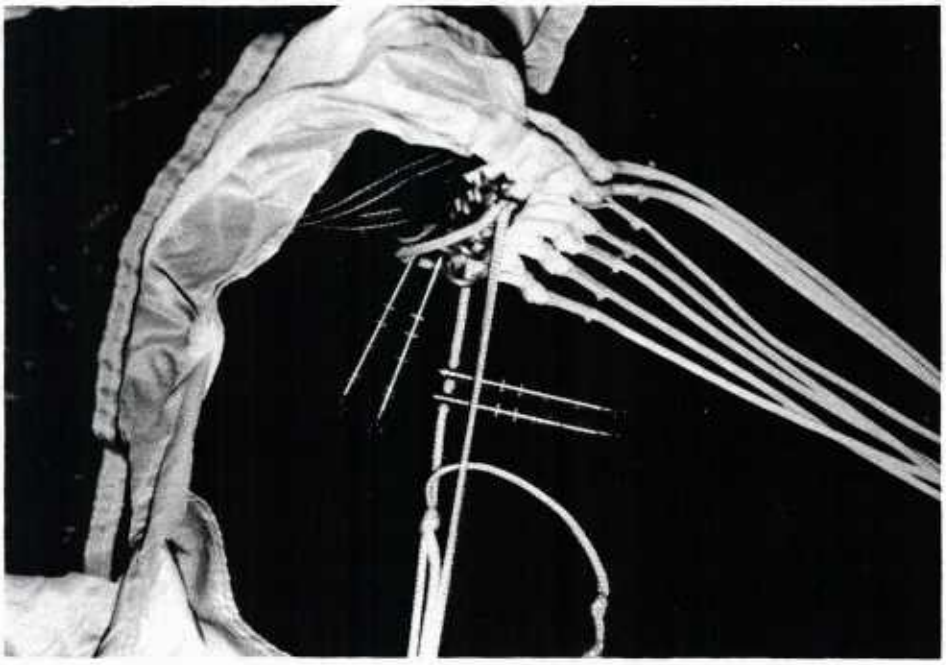

FIGURE A-3. First-Stage Reefing Line (Small Loop) After Completion of Step 6b. Note knot in second stage reefing line and cutters on both reefing lines.

FIGURE A-4. Cutter Firing Pin and Ring, Firing Lanyard, and the No. 0 Grommet in the End Flap of the Deployment Bag.

Appendix B

EJECTION TEST AUTHORIZATION, TEST PLAN, AND ABORT CRITERIA

DEPARTMENT OF THE NAVY
NAVAL WEAPONS CENTER
CHINA LAKE, CALIFORNIA 93555

IN REPLY REFER TO:
13100
Reg 6422-99
30 Aug 1984

MEMORANDUM

From: Head, Test Engineering Section (Code 64221)
To: Chairman, Aircraft Safety Committee (Code 063)

Subj: REQUEST FOR INFLIGHT EJECTION AUTHORIZATION

Encl: (1) SJU-8/A Ballistic Schematic
(2) SJU-8/A Ballistic Listing
(3) Trajectory Chart for Normal Ejection Sequence
(4) Trajectory Chart In Case Of Rocket Motor Failure
(5) Interface Attachment Analysis

1. Authorization is requested for the conduct of inflight ejections out of a manned YF-4J aircraft to evaluate the Air Gliding Escape System (AGES) parachute assembly in an ejection environment. Current flight test criteria calls for a ejection velocity of 500 KEAS at 5,000 feet AGL; with the aircraft being in a straight and level flight.

2. The basic escape system consist of a Stencel SJU-8/A ejection seat which is approved for service use in the A-7 and TA-7 aircrafts. The SJU-8/A ejection seat utilizes a DART brake device which corrects for pitch and roll instability during the initial stages of ejection. This device is deployed using two 2,400 pound nylon lanyards attached to the catapult manifolds of the guide tubes. As the seat passes through about 21 feet of stroke, the lanyards disengage from the seat and will subsequently stream or lay down against the external surface of the aircraft fuselage. Amount of lanyard trailing behind the rear bulkhead of the aft cockpit will equal approximately 15 feet. The SJU-8/A ejection seat for this test will also incorporate two aerodynamic stabilizers (fins) which are normally stowed along each seat side panel. In a similar fashion these fins are erected by the use of two nylon lanyards as the seat egresses the cockpit. As a result, the free length of line outside the cockpit lying against the external surface of the aircraft fuselage will equal about one foot.

3. The M-99 initiators normally used for the ejection sequence will be removed and substituted with one electrically initiated M-53 pressure actuated initiator which will be controlled by the pilot. Other safety features to be incorporated are the installation of a shunting plug/switch to assure that no current can be applied to the M-53 initiator during installation, and the installation of pilot controlled de-arming guillotine in case of hange fire (see enclosure (1)). Enclosure (2) is a listing of all pyrotechnics used on the ejection seat.

4. The aft cockpit canopy will be removed for these tests. Enclosure (3) depicts the ejection trajectory of a three percentile dummy and seat mass at 450 KEAS. The trajectory does not change significantly for a five percentile dummy at 500 KEAS. Enclosure (4) depicts the trajectory of the dummy/seat mass relative to the aircraft if none or only one rocket would fire.

Subj: REQUEST FOR INFLIGHT EJECTION AUTHORIZATION

5. The aircraft electrical system installation and check-out will be performed by Code 6133 (Systems Engineering Branch). The seat/aircraft interface installation, seat build-up and installation in the aircraft will be performed by Stencel Aero Engineering personnel in accordance with their procedures and checklist. Enclosure (5) is a strength analysis of the interface attachment.

6. The first test is tentatively scheduled for the week of 17 September 1984. If additional information is required, please contact Mr. deHaan at extension 2135/6 or Mr. R. Sanford at extension 2943.

H. A. DEHAAN

Copy to:
063A
6115
6133
64
6402
6403 (Stiff, Sanford)
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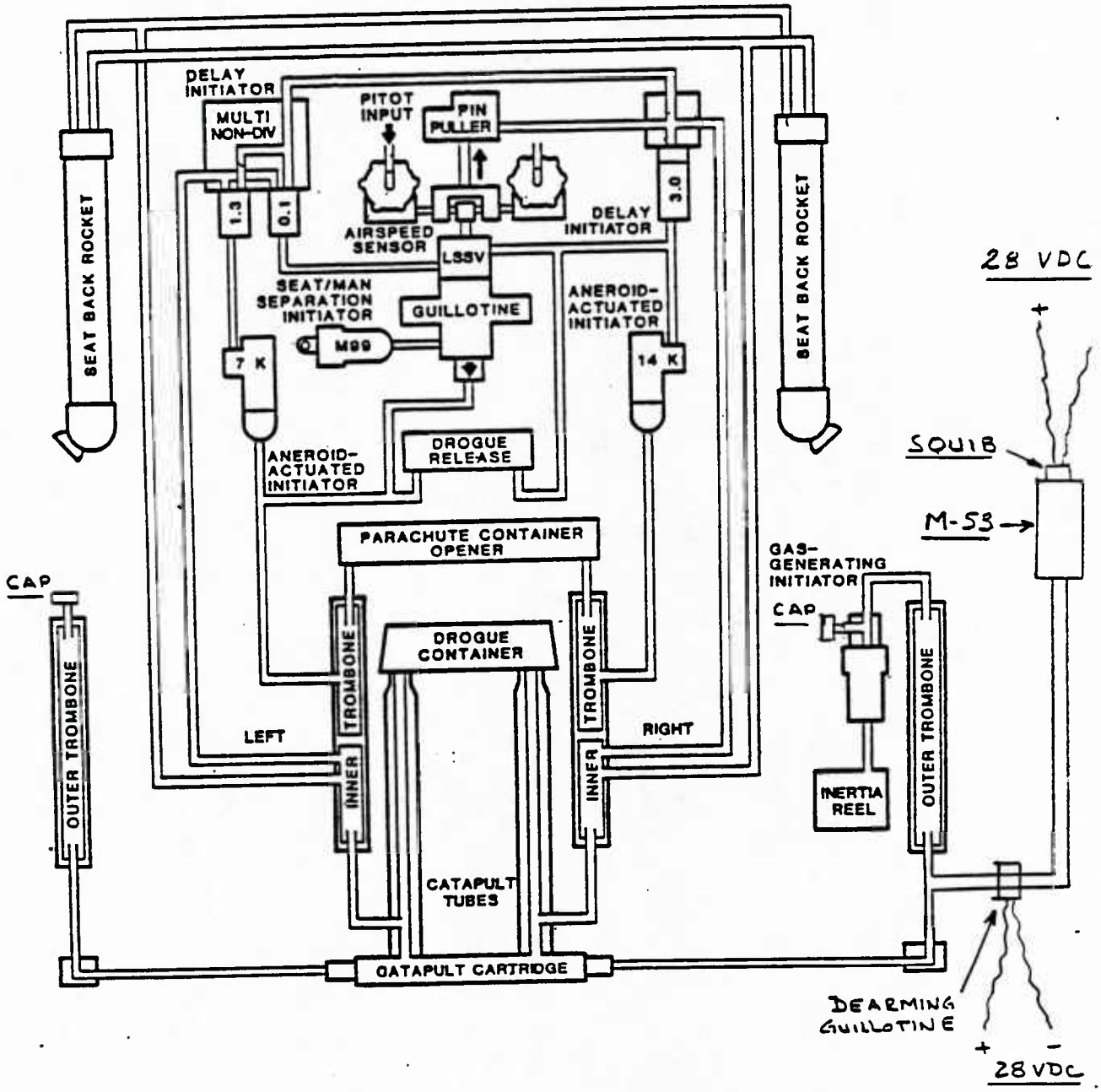
6422___ (deHaan, file)

SIIIS-3ER (SJU-8/A) BALLISTIC SCHEMATIC



ENCL. 1

SJU-8/A BALLISTICS

QTY.	P/N	DESCRIPTION	CLASS
2	472V495D001-7	SEAT BACK ROCKET	"B"
1	12240-5	WORD ROCKET	"B"
1	12641-1	CATAPULT CARTRIDGE	"B"
1	12063-1	MULTIPLE TIME DELAY CARTRIDGE	"C"
1	12065-3	3.0 SECOND TIME DELAY CARTRIDGE	"C"
2	1092-20	ANEROID CARTRIDGES	"C"
1	472V440D001-3	INERTIA REEL INITIATOR	"C"
1	M-53	INITIATOR	"C"
1	M-99	INITIATOR	"C"
1	3003	HOLEX SQUIB	"C"

Encl. 2

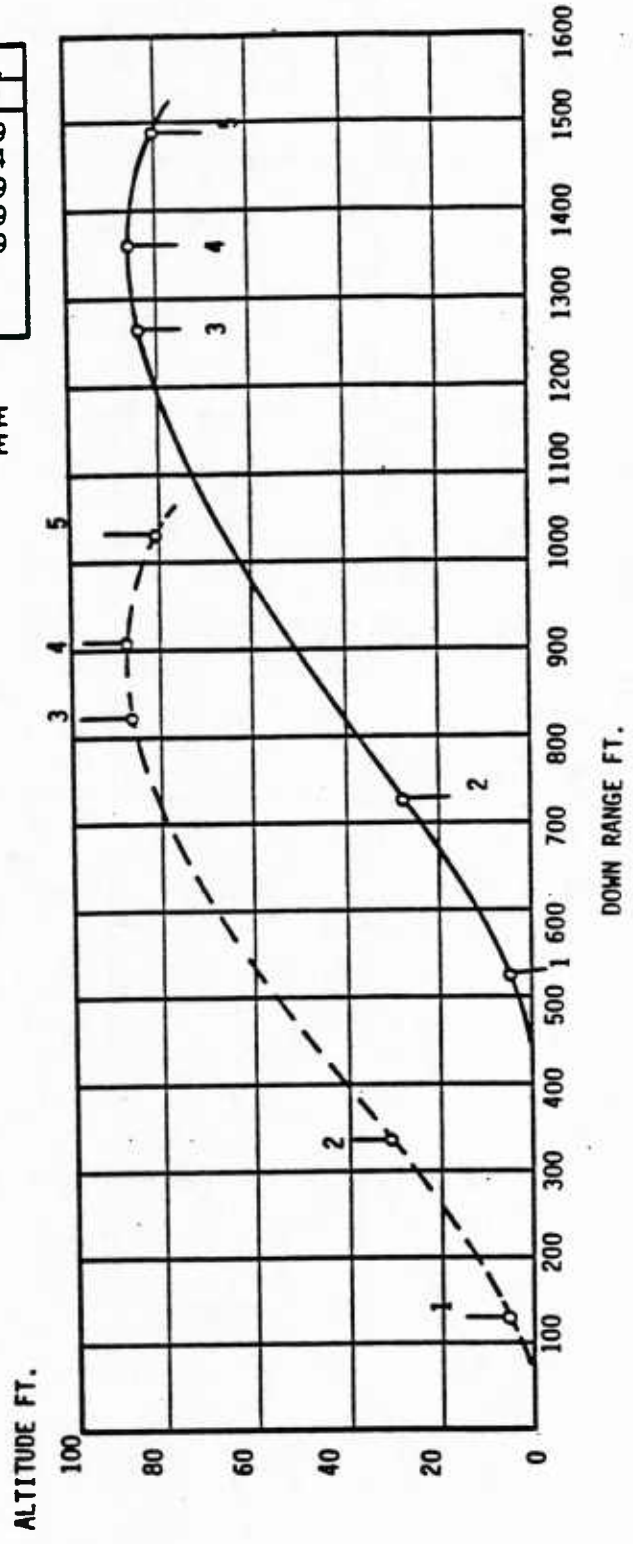
12T1105A

EVENT	TIME SEC. AFT	FWD
1. CAT SEP	.19	.69
2. SBR BURN	.44	.94
3. PACK OPEN	1.49	1.99
4. SPR GUN	1.29	2.29
5. FFI	2.79	3.29
6. VERT DES		
7. GROUND IMP		

AFT - - - - 3 PERCENTILE
FWD ——— 98 PERCENTILE

TA - 7C TEST 4

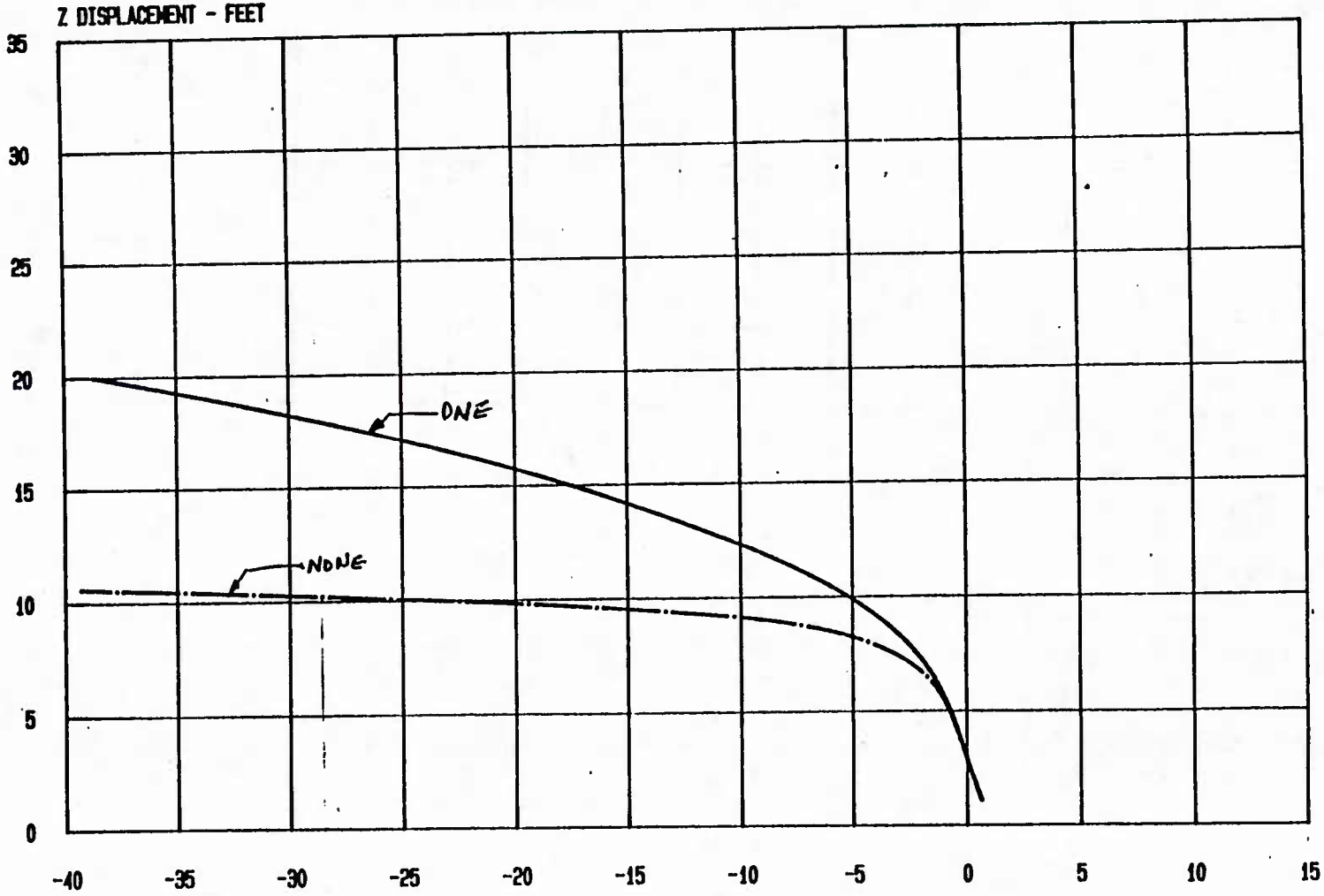
450 KEAS (HIGH SPEED MODE) TRAJECTORIES



ENCL. 3

450 KEAS FLIGHT TEST TRAJECTORIES

NO ROCKETS FIRED & ONE ROCKET FIRED



ENCL 4

N. Engle 8/17/84

Dwg. 12050

Check of F-4 Interface Installation (450 KEAS Test)

Catapult stroke will produce a load of 3780 lbs. (limit) or 5670 lbs. ultimate per side. For a Zero-Zero ejection tip-off loads on the upper slippers would be 8100 lbs. forward "pull" on the upper slippers. At 600 KEAS, the tip-off load is an aft "push" load of 7800 lbs. on the upper slippers. At 450 KEAS, the load is:

$$P_{slipper} = (450/600)^2 \times (7800+8100)-8100$$

$$P_{slipper} = 843 \text{ lbs. aft (push on slipper)}$$

Because this load will be reacted in bearing by the interface and the aluminum mounting plate, only the bolt shear loads due to catapult thrust (5670 lbs. ult. per side) need to be checked.

Check of Fastener Shear Loads

The fasteners are 1/4 - 28, assummed to be at least 125 KSI Ftu or 75 KSI Fsu. At 75 KSI Fsu, the shear allowable is 3682 lbs. per fastener. Four fasteners are used on each leg of the interface.

$$M.S._{Shear,ult.} = (4 \times 3682)/5670 - 1 = \underline{1.59}$$

Check Interface Bearing Capability

For 7075-T73511 Extrusions, Fbru = 130 KSI. For a .25 dia. hole thru a .188 inch thickness, Pbru = .25 x .188 x 130000 = 6110 lbs. per fastener. This is higher than the shear capability of the bolt. No further analysis is required.

ENCL. 5

STENCEL AERO ENGINEERING CORP.
Code ident. no. 24632
Talley Industries

Document No. 12T1541 **Rev.** ____
Contract No. N00019-79-C-0477 Modification P00028
CDRL Seq. No. ____
Date 23 August 1984
No. Of Pages 33

TEST PLAN AND PROCEDURE FOR YF-4 INFLIGHT TEST OF SJU-8/A EJECTION SEAT WITH AGES AND STABILIZATION FINS

Prepared by:

R. G. Chase
Technical Director,
Test & Parachute Development

8/23/84
Date

Approved by:

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Program Manager

8-23-84
Date

J. W. Duncan
Project Engineer

8.23.84

Customer approvals:

LIB - 1
JWD - 1
TS - 1
RGC - 1
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STENCEL AERO ENGINEERING CORPORATION

12T1541 Rev.

REVISION RECORD

REV.	DESCRIPTION	APPROVAL AND DATE
	RELEASE	

REV.																							
PAGE	1 & 2																						

REVISION STATUS OF PAGES — OTHER PAGES

ASTERISKS (*) SHOWN LOCATE CHANGES FROM PREVIOUS REV. FOR CONVENIENCE ONLY - NO LIABILITY ASSUMED

F302A

ABSTRACT

This test plan incorporates the purpose, detailed description and procedures for the inflight SJU-8/A Escape System demonstration utilizing the Aircrew Gliding Escape System (AGES) ram air inflated parachute and seat stabilization fins.

This test will be conducted at the Naval Weapons Center, China Lake, California, under the direction of the Parachute System Department. The test will consist of an inflight ejection of the Stencel SJU-8/A Escape System from the aft cockpit of the NWC YF-4 aircraft.

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1.0 SJU-8/A ESCAPE SYSTEM

The basic SJU-8/A ejection seat scheduled for use on this program has been fully qualified in accordance with the requirements of MIL-S-18471 and MIL-E-9426 and has been approved for service use for installation into A-7 and TA-7 aircraft.

1.1 Configuration Description. The general configuration of the SJU-8/A Escape System is shown in Figure 1.

The seat consists of (1) an adjustable seat bucket, (2) airspeed sensor assembly, (3) dual catapult tubes, (4) drogue parachute and WORD rocket, (5) dual seat back rockets, (6) a catapult cartridge device, (7) main parachute recovery assembly, (8) a DART system, (9) a survival kit assembly, and (10) several ballistic time delay devices, including a 14,000 foot and 7,000 foot aneroid.

1.2 Functional Description. When the aircrewman pulls the ejection control handle, two M-99 initiators are fired which in turn initiate the inertia gas generator and catapult ignitors. The catapult propels the seat/man from the cockpit. Catapult gases initiate drogue deployment, Seat Back Rocket (SBR) ignition and initiate the various time delays on the seat.

Inasmuch as the seat can operate in five different modes, drogue release and main parachute opening times will vary depending upon airspeed and altitude. The five modes of operation are as follows:

a. Mode 1 operates below 225 KEAS airspeed and 7,000 feet altitude where the 0.1 second time delay shuttles the LSSV, opens the drogue release and fires the 14K aneroid. This releases the drogue and opens the main parachute container allowing the parachute to deploy and inflate.

b. Mode 2 is above 225 KEAS airspeed and below 7,000 feet altitude where the output of the 0.1 second time delay is blocked by the LSSV; the 1.2 second time delay fires the 7K aneroid which releases the drogue and opens the main parachute container.

c. Mode 3 is above 7,000 feet altitude where the output of the 0.1 second time delay is blocked by the LSSV and the 1.2 second initiator only cocks the 7K aneroid (which does not fire until the seat descends to 7,000 feet). The 3.0 second time delay then releases the drogue and fires the 14K aneroid which opens the main parachute container.

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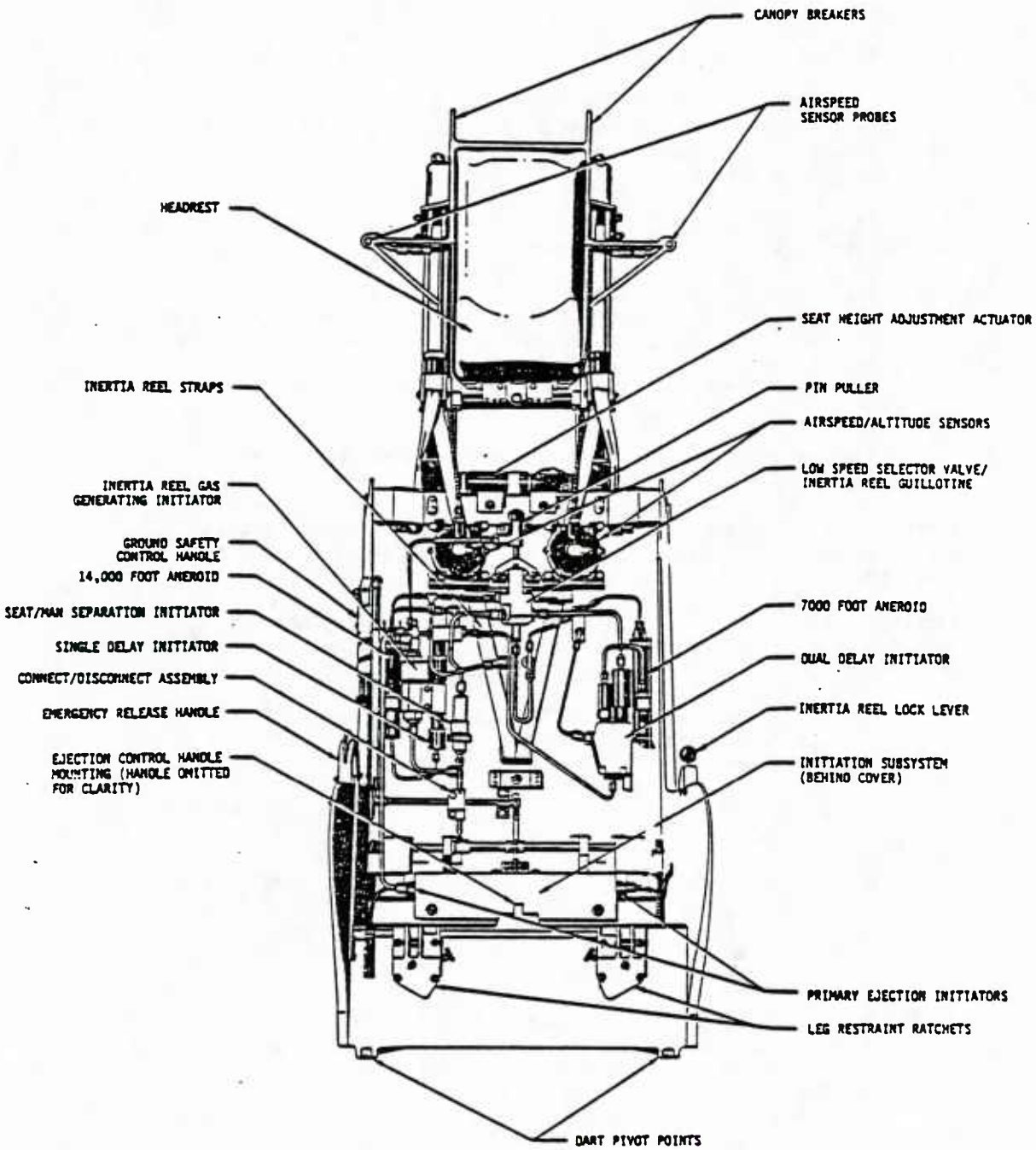

FIGURE 1. LOCATION OF SJU-8/A MAJOR ELEMENTS, ASSEMBLIES, AND COMPONENTS

d. Mode 4 is above 14,000 feet altitude where Mode 3, above, operates down to the 14K aneroid which cocks but does not fire until the seat/man descends to 14,000 feet where the main parachute container is opened.

e. Mode 5 is selected when the crewmember operates the emergency release handle before the appropriate time delay above fires. In this case the seat/man separator initiator actuates the guillotines, releases the drogue and opens the main parachute container.

1.3 Escape System Modifications. The basic SJU-8/A seat used for this test will be modified as follows:

1. The seat bucket mounted M-99 initiators normally used for ejection will be removed and substituted with one electrically initiated M-53 pressure actuated initiator. This initiator will be mounted to the aircraft bulkhead (Figure 2).

2. The normally used 28-foot flat circular parachute will be replaced with the Ram Air inflated Aircrew Gliding Escape System (AGES) parachute. Initial pack open and canopy extraction will be unchanged.

3. The seat bucket will include the installation of deployable stabilization wings. The wings are normally in a stowed state positioned along the seat side panels and are deployed by use of nylon lanyards as the seat is ejected from the cockpit of the aircraft.

4. The aircrew survival kit including raft stowed under the seat pan assembly will be removed and replaced with a 24-foot flat circular parachute which will be deployed upon seat/man separation and recover the seat.

5. Other minor deviations will be incorporated to accommodate visual event indicators and instrumentation as required. Such modifications will not interfere with seat design or performance characteristics.

1.4 Test Dummies. NWC supplied instrumented anthropomorphic dummies (3 or 98 percentile) shall be used for this test. The selected dummy shall conform to USN anthropometric standards. CG location of the combined seat/dummy shall be established and recorded by Stencel for inclusion into the test report.

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SIIIS-3ER (SJU-8/A)
BALLISTIC SCHEMATIC

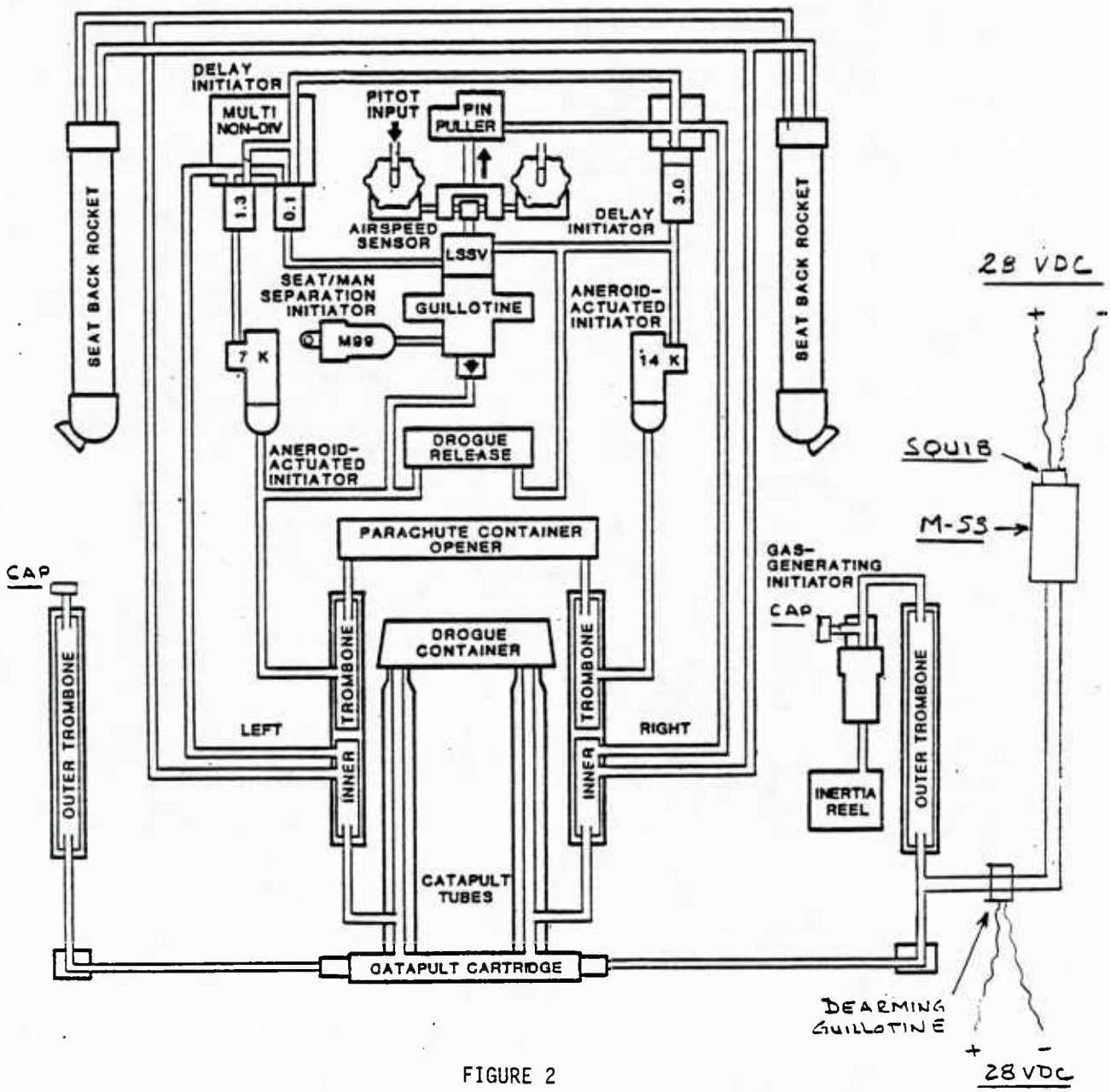

FIGURE 2

1.5 Safety Considerations.

1.5.1 Hazardous Tests. The functional tests described herein pose operational hazards and possible injury to personnel in the test area. All aspects shall be considered affecting the safety of personnel conducting the tests.

CAUTION: Only qualified personnel and qualified witnesses will be allowed in the vicinity when the tests are conducted.

Procedures outlined in SAEC Safety Manual 111HSA931-001 will be followed at all times.

1.5.2 Handling of Test Articles. The test articles shall be handled, stored and transported in a manner that shall not exceed conditions or environments beyond those imposed by required tests which may influence the results of subsequent tests.

1.5.3 Hardware Damage. Should a test article be damaged during handling, further testing shall be discontinued until it has been inspected and approved for further testing by the responsible Test Engineer. Such an event and subsequent disposition shall be noted in the individual test log sheet.

2.0 TEST PURPOSE

The primary purpose of this test is to demonstrate AGES system compatibility with the SAEC SJU-8/A ejection seat and to further study the stability effects of the seat with the installation of stabilization fins.

3.0 TEST DESCRIPTION

3.1 Test Conditions. One test of the configuration described herein is scheduled. Conditions are listed below in Table I.

TABLE I

TEST CONDITIONS

Test No.	Altitude MSL	Velocity	Test Vehicle	Dummy %tile	Seat Bucket Position
1	7500	500 KEAS	YF-4	98	Down

NOTE: Nominal seat/dummy CG will be used.

3.2 Test Profile. This test will involve the ejection of a complete SJU-8/A ejection seat with 98%tile dummy installed from the aft cockpit of the NWC furnished FY-4 aircraft. The ejection velocity of 500 KEAS at 7500 feet MSL will result in a parachute pack open on approximately 225 KEAS when operating in the 1.3 second high speed mode. See Figure 3. Inasmuch as the 7,000 foot aneroid may or may not allow the seat to operate in the 1.3 second mode due to tolerances, it will be required to incorporate the 14,000 foot aneroid into that Ballistic Signal Transmission System (BSTS) subsystem. Ejection signal will be provided by the forward occupant of the FY-4 aircraft.

3.3 Event Sequencing. The following events in the order listed are predicted for the ejection sequence and subsequent recovery.

1. Seat ignition T = 0.
2. Inertia reel gas generator initiation.and catapult ignition.
3. First seat motion.
4. Drogue projection.
5. Seat sequencing mode selection and SBR ignition.
6. Catapult separation.
7. WORD release.
8. Main parachute pack open.
9. WORD ignition.
10. Main chute pack extraction.
11. Line stretch and parachute reef open.
12. Seat/dummy separation.
13. Parachute full open.
14. Ground impact.

NOTE: The seat assembly will be recovered using a Stencel furnished 24-foot flat circular parachute. The chute will be stowed within the araa of the survival kit and will be static line deployed at seat/dummy separation.

4.0 SAFETY PRECAUTIONS

4.1 Safety.

WARNING: Do not approach the test vehicle at any time without complete knowledge of the risks and hazards attendant to its then present condition. The SAEC Test Engineer is the only SAEC representative who can grant permission to approach the vehicle while it is being prepared for testing. Once the test vehicle has been placed on the NWC flight line, it is the NWC Project Engineer's responsibility with the cognizance of the SAEC Test Engineer to allow or not allow visitors or technicians to approach the vehicle.

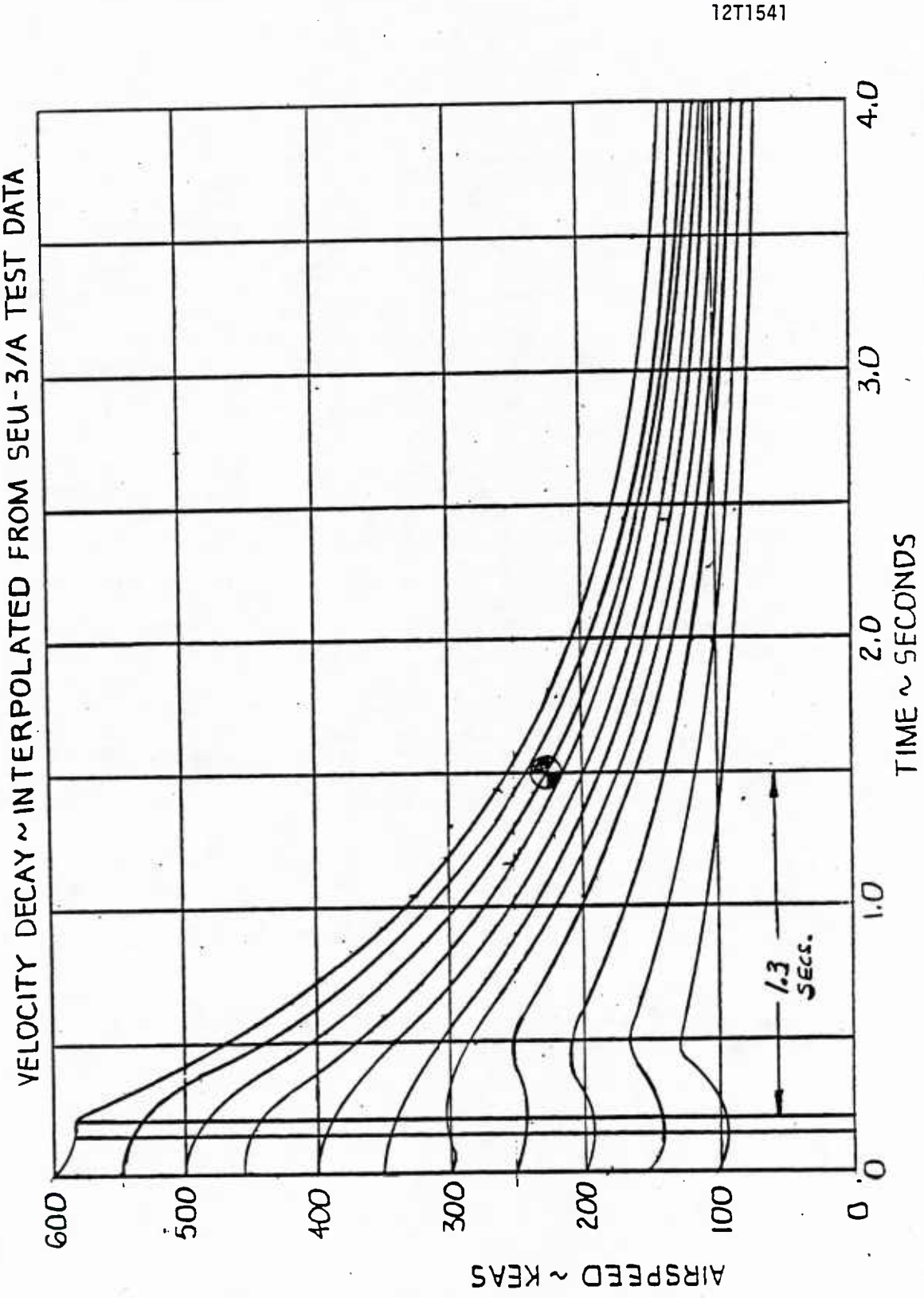
12T1541
VELOCITY DECAY ~ INTERPOLATED FROM SEU-3/A TEST DATA
AIRSPEED ~ KEAS
600
500
400
300
200
100
0
TIME ~ SECONDS
0
1.0
2.0
3.0
4.0
1.3 SECS.

FIGURE 3

4.2 Test Site Safety Operations. Test site operations shall be performed in accordance with applicable NWC Safety Procedures.

4.3 Ground Safety Control System. This system places the seat in "Safe" or "Armed" conditions. For a "Safe condition," the lever is pulled upward. This action prevents initiation signals from firing any initiators normally installed. It will not safety the initiation system used for this test.

4.4 Ejection Control System. The primary ejection control handle normally initiates the ejection sequence; however, for this test, this control will be bypassed and the system initiated electrically. Holex 3003 Series 1 watt, 1 amp pressure cartridges or equivalent, have been selected for this ignition system.

4.5 General Precautions. The SJU-8/A Ejection Seat System contains pyrotechnic devices which do have a qualification history. Since these devices contain propellants and explosives they should be handled with that consideration normally assigned to ballistic items.

4.6 Rockets and Catapult. The catapult and rockets are initiated by gas pressure. Care shall be exercised to prevent pressure from being directed into the respective rocket or catapult gas port except as required for tests.

4.7 High Pressure Gases. The SJU-8/A Sequencing Subsystem, rockets, and catapult, operate through the utilization of high pressure, high temperature gases. A failure of hardware during operation may result in dispersion of metal fragments and ignited propellant. During test preparation and operation it is mandatory that all personnel and equipment be positioned at a distance from the test unit which will ensure no personnel or equipment damage.

4.8 Descending Hardware. Consideration shall be given to existing wind conditions during testing to ensure that descending test hardware, both under parachute and ballistic trajectory/free falling, will impact at a safe distance from all personnel and equipment. (NWC responsibility)

4.9 Irritant Fumes. Consideration of wind directions and personnel placement shall be exercised to reduce the possibility of personnel inhaling irritant fumes exhausted by the rockets and catapult.

4.10 Handling. The test assembly shall be handled, stored, and transported in a manenr that shall not cause conditions or environments which are in excess of those required by the tests.

4.11 Hardware Damage. In the event a test unis is inadvertently damaged during handling, further testing of the unit shall be discontinued until it has been inspected and approved for further testing by the responsible NWC Range Engineer, with the cognizance of the SAEC Test Engineer.

4.12 Post-Test Clearance. In the event a test unit fails to activate on command, it shall not be approached or handled until clearance has been granted by the responsible NWC Range Engineer, with the cognizance of the SAEC Test Representative. Such a failure shall be assumed if the seat fails to leave the test aircraft under catapult power stroke.

4.13 Malfunctioned Hardware. In the event a test unit is activated but fails to operate correctly, the touchdown point shall be visually marked. No personnel may approach the malfunctioned test unit until clearance has been granted by the responsible SAEC Test Representative with the cognizance of the NWC Project Engineer.

4.14 Explosive Handling. Handling of explosive material and devices shall be in accordance with DOD 4145,26M,DOD Contractor's Safety Manual for Ammunition, Explosives and Related Dangerous Material. All explosives handling and transportation at NWC will be accomplished by NWC. All SAEC procedures will conform to NWC standard operating practices. The NWC Project Engineer is the final authority on matters pertaining to the subject.

5.0 INSTRUMENTATION REQUIREMENTS

5.1 Telemetry. This flight test will utilize one telemetry package containing a minimum 10 channel recording capability. The dummy telemetering channel assignments are specified on Table II and shall be mutually agreed upon between NWC and Stencel. The NWC will be responsible for all aspects of this test and will include but not necessarily be limited to the reception of TM signal, acquisition of data, playbacks and ground station operations, maintenance and calibration of all TM packs and transducers.

TABLE II

TELEMETRY TEST EVENTS - DUMMY

Measurement No.		
1	Roll Rate	1500°/Sec
2	Yaw Rate	1500°/Sec
3	Pitch Rate	1500°/Sec
4	G_X Acceleration	± 25 g
5	G_Y Acceleration	± 25 g
6	G_Z Acceleration	± 50 g
7	Parachute L.H. Riser	5,000 lbs.
8	Parachute R.H. Riser	5,000 lbs.
9	Pack Open	Event
10	Seat/Man Separation	Event

5.2 Photography (Non Metric). The following photographic coverage will be required from NWC and will include those support areas such as manpower, cameras, timing, chase aircraft, lenses, film, developing, prints and identification.

1. Onboard Cameras - Two (2) 16mm cameras using color film at 400 pps.

2. Photo Chase - A minimum of one 16mm camera using color film at 200 pps.

3. Ground to Air - Two 16mm cameras using color film at 200-400 pps, one 35mm color at 120 pps and one video.

5.3 Photographic (Metric). Metric cameras (Askania) will be utilized to record range position, elevation, velocities, rates of descent and other parameters required by NWC.

5.4 Still Photo. Stencel requests that NWC provide manpower and equipment for the purpose of documenting pre and post-test activities as they pertain to this test. This would include seat buildup, aircraft installation, and post-test equipment photos. All coverage should be in color.

6.0 REPORTS AND DATA

Stencel requests that two copies of all photo, telemetry and space position data be provided within two weeks following completion of the test. Stencel shall prepare a test report 45 days following receipt of this data.

7.0 TEST FIXTURES AND EQUIPMENT REQUIREMENTS

7.1 The following Stencel furnished equipment will be provided in support of this test.

1. SAEC support as required.
2. SJU-8/A ejection seat and ballistics.
3. Interface assembly.
4. Seat sling.
5. CG fixture.
6. Seat recovery parachute assembly.
7. Miscellaneous tools, etc.
8. Visual event indicators.
9. Dearming guillotines.

7.2 The following items will be provided by NWC.

1. Telemetry systems and support.
2. Photo equipment and support.
3. Launch aircraft - YF-4.
4. Chase aircraft.
5. Facility for final assembly of test item.
6. Dummy.
7. Personnel flight clothing/equipment.
8. AGES parachute assembly.

8.0 TEST PREPARATION AND PROCEDURES

Test preparations at NWC will include the basic seat buildup and dummy preparation, seat aircraft installations and seat/aircraft arming and final closeout. Instruction check sheets depicting these procedures are contained in Appendices A through F. Stencel will assume the responsibility for the performance of these tasks along with the concurrence of NWC project and safety personnel.

9.0 HARDWARE DISPOSITION

With the exception of the AGES parachute, all test hardware is to be returned to Stencel, Asheville, N. C. Upon return, the System Effectiveness Department will perform a detailed Marginality of Success (MOS) evaluation. Results of this MOS will be included within the contents of the test report.

12T1541

APPENDIX A

TEST NO._____ CHECK LIST: SIIIS SEAT PREPARATION

ITEM NO.	DESCRIPTION	PERFORMED BY	WITNESSED BY NWC	WITNESSED BY SAEC	DAT
1.	Place seat in holding fixture and secure all attachments.	LW		RB	9/25/8
2.	Install headrest and torque NAS1225-3L bolt to 120 ± 20 in. lbs. Remove two safety pins.	LW		RB	9/24/8
3.	Remove wedge and RALSA (if installed) and perform a visual inspection. Record observations.	LW		RB	9/25/8
4.					
5.	Install drogue container and torque MS21262-25 bolts to 90-100 in. lbs.	LW		RB	9/24/8
6.	Log the following (if readily visible and/or available): Seat S/N S2R 0006 Drogue S/N_____ Parachute S/N_____ Headrest S/N_____ RALSA S/N N/A	LW		RB	9/24/8
7.	Assemble plumbing components to WORD/drogue release assembly. Verify all O-rings in place. Torque and stripe all fittings. (INERT) WORD S/N 233 Prop Lot No._____ Date Mfg._____ Release S/N 0365	LW		RB	9/25/8
8.	WORD motor safety pin removed. NOT APPLICABLE				

12T1541

TEST NO._____ SEAT PREPARATION

ITEM NO.	DESCRIPTION	PERFORMED BY	WITNESSED BY NWC	WITNESSED BY SAEC	DATE
9.	Install WORD/drogue release assembly on seat. Attach all plumbing fittings.	LW		RB	9/25/84
10.	Troque WORD/drogue release assembly attach bolts, 90-100 in. lbs.	LW		RB	9/25/84
11.	Connect WORD bridle and install flat head pin and cotter key.	LW		RB	9/26/84
12.	Connect drogue riser and install flat head pin, washer and cotter key.	LW		RB	9/26/84
13.	Position WORD in cradle and engage withdrawal lines in strap.	LW		RB	9/26/84
14.	Confirm "WORD" bridle routing.	LW		RB	9/26/84
15.	Install Guillotine/LSSV Assembly.	LW		RB	9/26/84
16.					
17.	Torque all fittings in accordance with MS21344.	LW		RB	9/26/84
18.	Remove airspeed plunger plug.	LW		RB	9/26/84

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TEST NO._____ SEAT PREPARATION

ITEM NO.	DESCRIPTION	PERFORMED BY	WITNESSED BY NWC	WITNESSED BY SAEC	DATE
19.	Insert rod and push on plunger to release force on airspeed sensor locking key.	LW		RB 9-25-84	9-25-84
	airspeed sensors are bias in the high speed mode				
20.	Remove key. Gently let plunger retract to assure a unlock position of the internal locking mechanism.	LW		RB 9-25-84	9-25-84
	airspeed sensors are bias in the high speed mode				
21.	Recock plunger and reinsert locking key, replace plug.	LW		RB 9-25-84	9-25-84
	airspeed sensors are bias in the high speed mode				
22.	Install thruster. Attach arming keys to thruster.	LW		RB 9-25-84	9-25-84
23.	Check seat bucket travel. Should be 5.00 ± .060 inches. (Use calibration rod) 5.03 R. Hi	LW		RB 9/26/84	9-25-84
24.	Verify proper operation of Ground Safety Control Handle.	LW		RB	9-26-84
25.	Verify proper operation of Inertia Reel and Control Handle. Check IR strap travel.	LW		RB	9-26-84
26.	Ground Safety Control Handle up (SAFE) and locked.	LW		RB	9-26-84
	CAUTION: Attach grounding wire to seat and maintain until seat is ready to be moved by track personnel to test site. Personnel who perform buildup tasks will wear proper garments while in contact with seat.				

12T1541

TEST NO._____ SEAT PREPARATION

ITEM NO.	DESCRIPTION	PERFORMED BY	WITNESSED BY NWC	WITNESSED BY SAEC	DATE
27.	Install two (2) pressure transducers to airspeed sensor system.	N/A		DB	9-26-84
28.	Torque all fittings in accordance with MS21344. Torque -3 fittings to 95-105 inch pounds; the -4 fittings shall be torqued to 135-150 inch pounds. Seal all fittings when properly torqued.	LW		9/25/84 RB	9-25-84
29.	Install P/N 12065 (3.0 sec.) delay initiator S/N 135, L/N UA-82C001-005 Date Mfg._____.	LW		RB 9/25/84	9-25-84
30.	Install P/N 12063 multiple time delay initiator S/N 0514, L/N UA-82C001-003 Date Mfg._____.	LW		9/25/84 RB	9/25/84
31.	Install all required caps/plugs to seat plumbing per applicable schematic and specify below. A_____ D_____ B_____ E_____ C_____ F_____			DB 9/25/84	9/25/84
32.	Install cartridge in 14K aneroid. Aneroid S/N 2988 Lot No. 411-2454 Date Mfg. 1-82. Cartridge S/N 02240 Lot No. 79-537 Date Mfg. 12-79.	LW		9-25-84 RB	9/25/84
33.	Install cartridge in 7K aneroid. Aneroid S/N 2283 Lot No. 411-2046 Date Mfg. 5-80. Cartridge S/N 02222 Lot No. 79-537 Date Mfg. 12-79.	LW		9-25-84 RB	9/25/84

12T1541

TEST NO._____ SEAT PREPARATION

ITEM NO.	DESCRIPTION	PERFORMED BY	WITNESSED BY NWC	WITNESSED BY SAEC	DATE
34.	Install 14K aneroid. Installed on R.H. side	LW		RB	9/25/84
35.	Install 7K aneroid. Installed on R.H. side	LW		RB	9/25/84
36.	Install seat/man separation M-99. Do not install headed pin. Reinstall M-99 shipping pin. M-99 S/N 1268 Lot No. CHI-83-D-88-01 Date Mfg._____	LW		RB	9/25/84
37.	Confirm M-99 shipping pin installed.	LW		RB	9/25/84
38.	Install inertia reel gas generator. Initiator S/N____ L/N____ Cartridge S/N____ L/N____ Date Mfg.____ NOT APPLICABLE				
38A	Install left and right hand upper SBR Murphy plates with rivets.	LW			
39.	Install live left hand SBR. Torque and seal all fittings S/N 3463 L/N MC82M001-033 PROP mfg date 12/82	LW		RB	9/25/84
40.	Install live right hand SBR. Torque and seal all fittings S/N 3498 L/N MC82M001-032 PROP mfg date 12/82	LW		RB	9/25/84
41.	Connect main chute risers and verify continuity. Secure in place with four bolts and nuts -4 places.	LW		RB	9/26/84
42.	Engage seat/man separation lanyard on bellcrank - each side of bucket (two places). N/A LW			RB	9/26/84

12T1541

TEST NO._____ SEAT PREPARATION

ITEM NO.	DESCRIPTION	PERFORMED BY	WITNESSED BY NWC	WITNESSED BY SAEC	DATE
43.	Install MAINTENANCE STREAMER SAFETY PIN in S/M separation M-99 receptacle.	LW		RB	9/26/84
44.	Connect S/M separation M-99 firing pin to multiplying arm with appropriate hardware.	LW		RB	9/26/84
45.	Remove shipping pin from S/M separation M-99.	LW		RB	9/26/84
46.	Confirm shipping pin removed from seat/man separation M-99.	LW		RB	9/26/84
47.	Ensure ground safety control handle is up (SAFE) and locked.	LW		RB	9/26/84
48.	Visually scan seat back fwd surface for all mechanical attachments complete, brackets attached, and plumbing lines torqued and striped.	LW		RB	9/26/84
49.	Position and fasten initiation subsystem cover.	LW		RB	9/26/84
50.	Remove MAINTENANCE SAFETY PIN and install wedge.	LW		RB	9/26/84
51.	Reinstall MAINTENANCE SAFETY PIN. Be sure it is secure.	LW		RB	9/26/84

12T1541

TEST NO._____ SEAT PREPARATION

ITEM NO.	DESCRIPTION	PERFORMED BY	WITNESSED BY NWC	WITNESSED BY SAEC	DATE
52.	Ensure that pack open flashbulb clip insulator is in place, all flashbulbs not hooked up.	LW		MB	9/26/8
53.	Remove insulating tape and attach battery lugs to the proper terminals (2 & 3).	LW		MB	9/26/8
54.	Using VOM, verify that when pack open clip insulator is removed, power is at bulb connectors. Reinstall insulator.	LW		MB	9/26/8
55.	Ensure the ground safety control handle is in the up (SAFE) and locked position. Rotate emergency release handle up and verify that power is available at bulb connectors and removed when handle is returned to down position.	LW		MB	9/26/8
56.	Place tape over all terminal board screws.	LW		MB	9/26/8
57.	Position and tie/tape in place T/M pack open and seat/man separation breakwires.	LW		MB	9/26/8
58.	Prepare RALSA kit. Kit contents Recovery Parachute Weight 25 lbs.				
59.	Install RALSA. Verify hooks engaged and release handle down and locked.	LW		MB	9/26/8

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TEST NO. _____ SEAT PREPARATION

ITEM NO.	DESCRIPTION	PERFORMED BY	WITNESSED BY NWC	WITNESSED BY SAEC	DATE
60.	Install (plug in) restraint straps to ratchet assy. Be certain rings are on straps.	LW		JZB	9/26/84
61.	Pull on leg lines to ensure proper engagement under RALSA platform.	LW		JZB	9/26/84
62.	Verify kit release handles properly stowed.	LW		JZB	9/26/84
63.	Install RALSA cushion.	LW		JZB	9/26/84
64.	Install wedge cushion.	LW		JZB	9/26/84
65.	Install headrest cushion.	LW		JZB	9/26/84
66.	Weight completed seat 162 lbs. Complete with RALSA	Bryson/LW	(BrN)	Bryson	10/22/84

APPENDIX B 12T1541

CHECKLIST

TEST NO._____ DUMMY PREPARATIONS

ITEM NO.	DESCRIPTION	PERFORMED BY	WITNESSED BY NWC	WITNESSED BY SAEC	DATE
1.	Record dummy S/N Hybrid 3 .5%	Ryder			1/20/87
2.	Dummy Damage Chart. Record damage.	NA			
3.	Weigh the nude dummy and record. WEIGHT: NA				
4.	Adjust dummy limbs for 1 g, barely restraining the weight of the limb when extended horizontally. Leg joints shall be adjusted with the torso in supine position.	NA			
5.	Adjust head, neck and torso joints so they shall not move at a horizontal accelerated load of 1 g in the test position, but shall move at a horizontal load of 2 g's.	NA			
6.	Equipment Damage Chart. Record damage.	NA			
7.	Dress dummy as follows: 6 3%ile 98%ile Flight suit Exposure suit Boots ✓ Gloves ✓ Helmet ✓ Oxygen Mask and hose assy ✓ Survival/flotation vest — Anti-G suit ✓ TORSO HARNESS ✓	PW			1/20 Ryder

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CHECKLIST

TEST NO._____ DUMMY PREPARATIONS

ITEM NO.	DESCRIPTION	PERFORMED BY	WITNESSED BY NWC	WITNESSED BY SAEC	DATE
8.	Ensure that umbilical is routed down outboard side of RH leg and lanyard secured to calf by hose clamps and tape.	NA			10/22/82
9.	Route wires from chest package to pack open and seat/man separation wires on seat.				
10.	Weight of dressed dummy 150.00 lbs.	PW			10/22/82

APPENDIX C 12T1541

CHECKLIST

SEAT CG

WARNING: MAINTAIN ELECTRICAL GROUND OF SEAT AT ALL TIMES
MAINTAIN SAFE/ARM HANDLE IN SAFE POSITION

ITEM NO.	DESCRIPTION	PERFORMED BY	WITNESSED BY NWC	WITNESSED BY SAEC	DATE
1.	Assure CG fixture is correctly assembled and leveled.				
2.	Secure the seat in the fixture.				
3.	Adjust the seat for the particular test; FULL UP for the UP or FULL DOWN for . Note seat position.				
4.	Secure the dummy in the seat as follows: a. Place CG fixtuer in Z (down) position. b. Hoist dummy up and position in seat. c. Secure dummy in seat by connecting lap belt and riser Koch fittings. d. Tighten lap belt.				
5.	Attach personnel services.				
6.	Attach restraint straps to leg garters.				

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CHECKLIST

SEAT CG

ITEM NO.	DESCRIPTION	PERFORMED BY	WITNESSED BY NWC	WITNESSED BY SAEC	DATE
7.	Attach stow and tape instrumentation wires and connectors.				
8.	Place CG in X (upright) position and check security and tightness of all straps.				
9.	Lock inertia reel and snug up shoulder straps.				
10.	Position dummy's hands above lower firing handle and tie together with 1500 lb. cord or equivalent.				
11.	Determine center of gravity and record on following sheets.				

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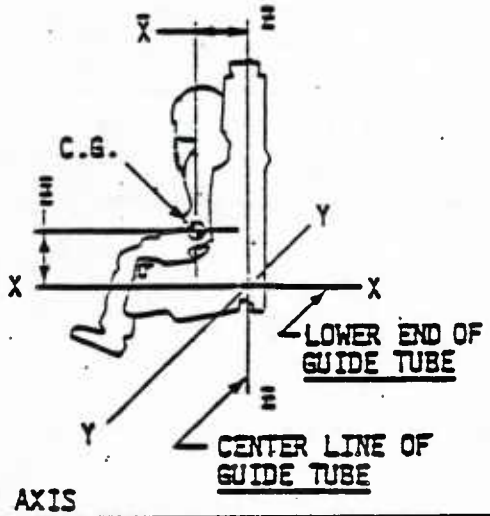
CENTER OF GRAVITY AND WEIGHT DATA

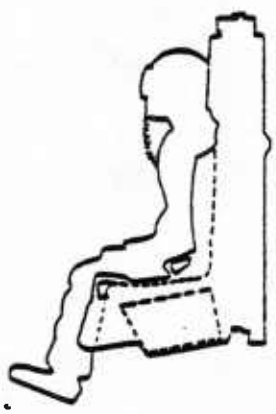


TEST SITE: NWC CHINA LAKE
SAEC TEST NO.: F4/S2R/FLEES
TEST DATE: 10/23/84
DUMMY PERCENTILE: 5% (FEMALE)
VERTICAL SEAT ADJ.: FULL UP

TEST ARTICLE WEIGHTS (LBS)

DUMMY (S/N 1HB3)	5%
COVERALL	✓
BOOTS (SIZE ____)	✓
GLOVES	✓
HELMET (SIZE ____)	✓
OXYGEN MASK	✓
O_2 HOSE & CONNECTOR	✓
SURVIVAL VEST	
ANTI-G SUIT	✓
PRESSURE SUIT	
FLOTATION VEST	
TORSO HARNESS	✓
ANTI-EXPOSURE SUIT	

BALLAST QUANTITY & LOCATION



TOTAL DUMMY DRESSED WT.:	150.00
TOTAL SURVIVAL KIT WT.:	—
*TOTAL SEAT ASS'Y WT.:	162.00
TOTAL BALLAST WT.:	312.00
*TOTAL EJECTED WT.:	312.00

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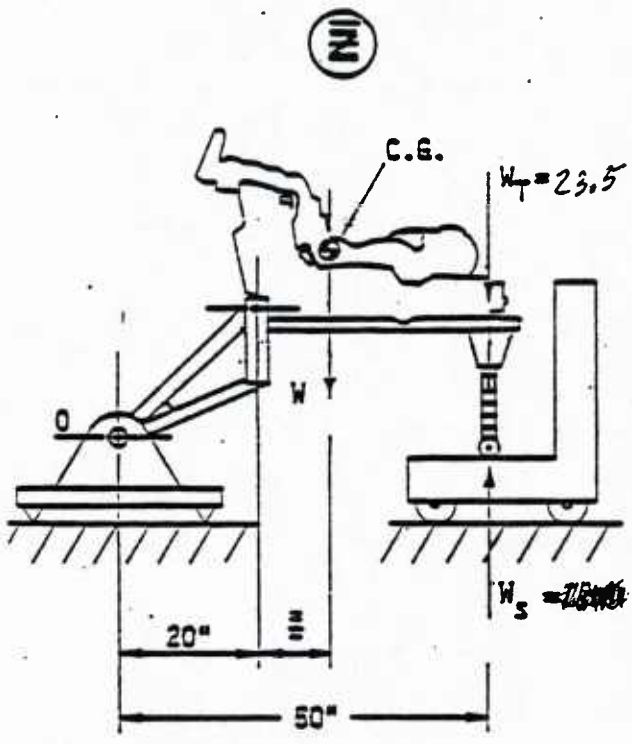
SAEC TEST NO.: NWC F4



$\Sigma M_O = 0 = W(20 + \Xi) - 50(W_S - W_T)$

$\Xi = \frac{50}{W}(W_S - W_T) - 20$

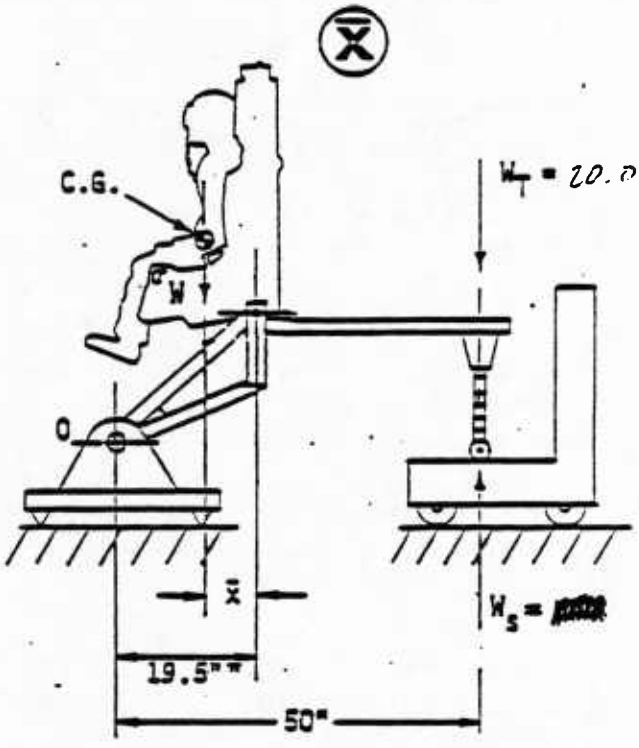
312 256 23.5

$\bar{Z} = Z' - AE$ 17.26

$\bar{Z} =$ 17.26

AC = Actuator Extension 5.00 inches

12.26-6



$\Sigma M_O = 0 = W(19.5 - \bar{x}) - 50(W_S - W_T)$ 83 − 20

$\bar{x} = 19.5 - \frac{50}{W}(W_S - W_T)$ 312 83 20.0

$\bar{x} =$ 9.44

* Compensates for .5 shim behind interface mounting brackets

APPENDIX D

12T1541

CHECKLIST

TEST NO._____ FINAL SEAT PREPARATIONS

ITEM NO.	DESCRIPTION	PERFORMED BY	WITNESSED BY NWC	WITNESSED BY SAEC	DATE
1.	Install catapult cartridge to seat. O-rings in place. S/N 429 Lot No. TAC82H001-003 (MFG 8/82 RCD 4/30/82)	RW			
2.	Install manifolds as required to catapult cartridge ignitors.				
3.	Connect trombones to manifolds via 4R6B-SS tee or as required by Test Plan. Torque and stripe.				
4.	Install initiation hose assy to 4R6B-SS as required.				
5.	Check connectors for no voltage and mate seat flashbulb connectors. Tape together and to seat.				
6.	Install SFM switch. Use wax cord to secure top of plate to spacer bar. Tape wire temporarily to side of seat. Check for desired open circuit across pins A & B. Ensure wire does not interfere with DART.				

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CHECKLIST

TEST NO._____ FINAL SEAT PREPARATIONS

ITEM NO.	DESCRIPTION	PERFORMED BY	WITNESSED BY NWC	WITNESSED BY SAEC	DATE
7.	Connect squib leads to sequencer before placing seat into cockpit (sled).				
8.	Install seat.				

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APPENDIX E

SJU-8/A SEAT/AC INSTALLATION PROCEDURE

✓ 1. Install seat interface to mounting plate in rear cockpit of F-4 aircraft. Secure in place with eight (8) ¼ 28 bolts.

✓ 2. Install M-53 initiator one (1) to right side of adaptor plate with Adel clamp.

✓ 3. Verify onboard cameras are installed and loaded.

____ 4. Install flashbulb (T = 0).

✓ 5. Install seat/man to cockpit of test aircraft.

✓ 6. Lock the interface/seat together by functioning the lever on the top L/H side of the interface. Install security bolt and nut.

✓ 7. Conduct TM checkout and calibrate.

____ 8. Using Alinco squib motor: Measure bridgewire resistance of one (1) Holex 3003 ignitor and record value below:

Checked by NWC TEST personnel

Holex 3003 R/H Resistance = _____

NOTE: Bridgewire resistance values should read 0.95 ± 0.05 OHMS.

✓ 9. Place one (1) MS28778-5 "O"-ring on the Holex output end and insert into an 894-5 reducer.

✓ 10. Place one (1) MS28778-4 "O"-ring on the -4 end of the reducer. Install this unit to the M-53 initiator.

CAUTION

Insure that foil shunts are installed to ignitor connector.

____ 11. Have all necessary still photos taken.

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APPENDIX F

SJU-8/A FRT SEAT/AIRCRAFT ARMING AND FINAL CLOSE OUT

CAUTION

The final arming steps of the SJU-8/A ejection seat will be accomplished with the test aircraft (F-4) engines running. Because of the noise level of the operating engines and close proximity to engine intakes, participating individuals will be kept to a minimum. All nonparticipating personnel will be kept well clear of the area.

✓ 1. Date 10/23/84 Time 7:AM Test No. F-4 AGGS

____ 2. Personnel. BRYLOW, CW, LSOP, STAFFORD

✓ 3. Cockpit cameras in place (magazines, lenses) electrical connectors disconnected.

✓ 4. Cockpit flashbulb installed.

✓ 5. Dummy/seat umbilican connected.

✓ 6. Dummy/seat umbilical by (not thru) secondary firing handle.

✓ 7. Lap belt fittings attached and lap belt snug.

✓ 8. Inertia reel handle "locked" position.

✓ 9. Emergency release handle in "stow" position.

✓ 10. Shoulder harness fitting (riser fittings) attached to torso hraness and shoulder harness snug.

✓ 11. Helmet visor down and locked.

✓ 12. Oxygen mask straps snug.

✓ 13. Seat release level on interface down and locked.

✓ 14. Confirm all witnesses have viewed cockpit.

→ 15. Request plane captain to apply external power to aircraft.

O/C 16. Request pilot to actuate "ejection initiation" switch. Record voltage at ignition cable plug. _____VDC (SHD read ___25 VDC)

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✓ 17. Request pilot to secure switches.

✓ 18. Replace cockpit flashbulb.

✓ 19. Connect camera (2 ea.) electrical connectors. Tape in place.

✓ 20. Inform plane captain and pilot that the seat is ready to be armed.

✓ 21. Position safety control handle in "down and lock" (armed) position.

✓ 22. Remove safety pin from M-99 initiator.

____ 23. Ask pilot to start engines. N/A

✓ 24. Verify cockpit safe/arm switch is in "safe" position.

✓ 25. Request pilot turn T/M power on.

____ 26. Pilot close canopy over front cockpit.

____ 27. Using VOM (Volt-OHM-Meter), check ignition circuit for stray voltage as follows:

R/H side of seat.

✓ Pins A to B - No voltage
✓ Pin A to GND - No voltage
✓ Pin B to GND - No voltage

____ 28. Request pilot turn T/M power off. Relieved by NWC

____ 29. Repeat stray voltage check (Step 27). N/A

NOTE: Remove VOM from aircraft at this time.

✓ 30. Remove foil shunt from Holex squib.

✓ 31. Connect ignition leads to Holex squib on L/H and R/N side of seat.

✓ 32. Attach flex hose from R/H catapult to output port of M-53 initiator.

✓ 33. Remove all tools, etc. from the aircraft work area.

✓ 34. Advise NWC safety seat is armed and ready for test. Depart the area.

End of Check List

AGES INFLIGHT EJECTION
GROUND ABORT CRITERIA

1. NAVWPNCEN RANGE NOT OPERATIONAL; i.e., less then: 4 Radars, 3 M-45 camera sites, lack of computer, plotboard or video.

2. No Photo chase aircraft available.

3. Loss of Telemetry signal.

4. Surface winds in excess of 20 KTS at the DZ.

4. Adverse weather conditions for good photographic documentation.

5. Less then 30 minutes of remaining Range time prior to engine start.

6. Unsafe system conditions.

INFLIGHT ABORT CRITERIA

1. NAVWPNCEN Range NOT OPERATIONAL, i.e. less then: 4 Radars, 3 M-45 camera sites, lack of computer, plotboard and video.

2. Loss of entire telemetry signal

3. Surface winds in excess of 20 KTS.

4. Adverse weather conditions for good photographic documentation.

5. After one "Hot Fire;" i.e., after confirmation that electric current was transmitted to the M-53 initiator through means of cockpit indicator light, flashbulb or TM.

6. After two "Cold Fires" when no current was transmitted to the M-53 initiator.

7. Loss of all aerial photo aircraft.

PRE-LAUNCH PROCEDURES

NOTE: Scheduled Range time is RT.

1. RT-1 hour: Start Stencel's systems close out inspection and checklist.
2. RT-30 minutes: Pilot conducts YF-4J aircraft pre-flight inspection.
3. RT-20 minutes: (a) Pilot manned the cockpit
   (b) Start ground power unit
   (c) Conduct stray voltage and systems check.
4. RT-15 minutes: (a) Shut down ground power unit
   (b) Close pilot's cockpit canopy
   (c) Clear all non-essential personnel
   (d) Hook-up guillotine and initiator squib
   (e) Turn on telemetry
   (f) Remove safety pins
   (g) Start ground power unit
   (h) Start aircraft engines
   (I) Perform normal aircraft take-off procedures.

SEAT FIRING PROCEDURES

NOTE: (1) Seat ejection time is T.

(2) A "DRY RUN" will be required.

1. T-30 seconds: Telemetry signal confirmation.

2. T-20 seconds: Range camera tracking confirmation.

3. T-10 seconds: Turn Master Arm ON.

4. T-3 seconds: Activate "FIRE" button.

5. T-0 seconds: Seat ejection.

6. If the ejection seat did not leave the aircraft, report condition of FIRE indicator light in pilot's cockpit; i.e., green light ON or OFF.

ABORT PROCEDURES

1. After one "Hot Fire" confirmation (Through means of: Green indicator light, flashbulb or TM) activate the guillotine fire switch.

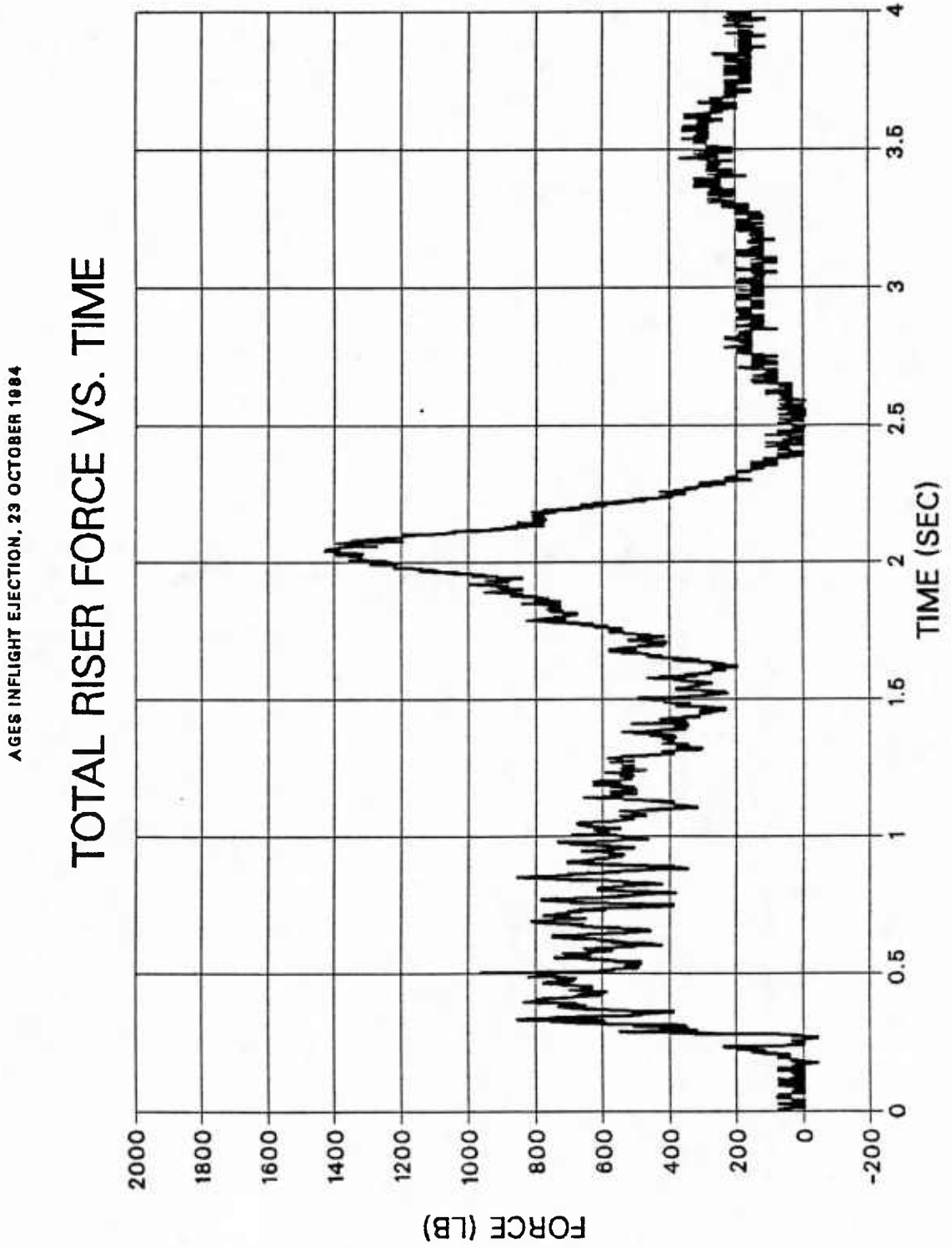
2. After first "Cold Fire" confirmation (No green light, flashbulb or TM indication) turn MASTER ARM switch OFF. Set-up for another pass.

3. After the second "Cold Fire" confirmation, turn MASTER ARM switch OFF, then activate the guillotine switch. Return to the Airfield and land at pilots dircretion.

4. After aircraft engine shutdown, turn OFF the telemetry and procede with Stencel's abort procedures.

Appendix C

NWC TEST DATA FOR AGES IN-FLIGHT EJECTION 23 OCTOBER 1984

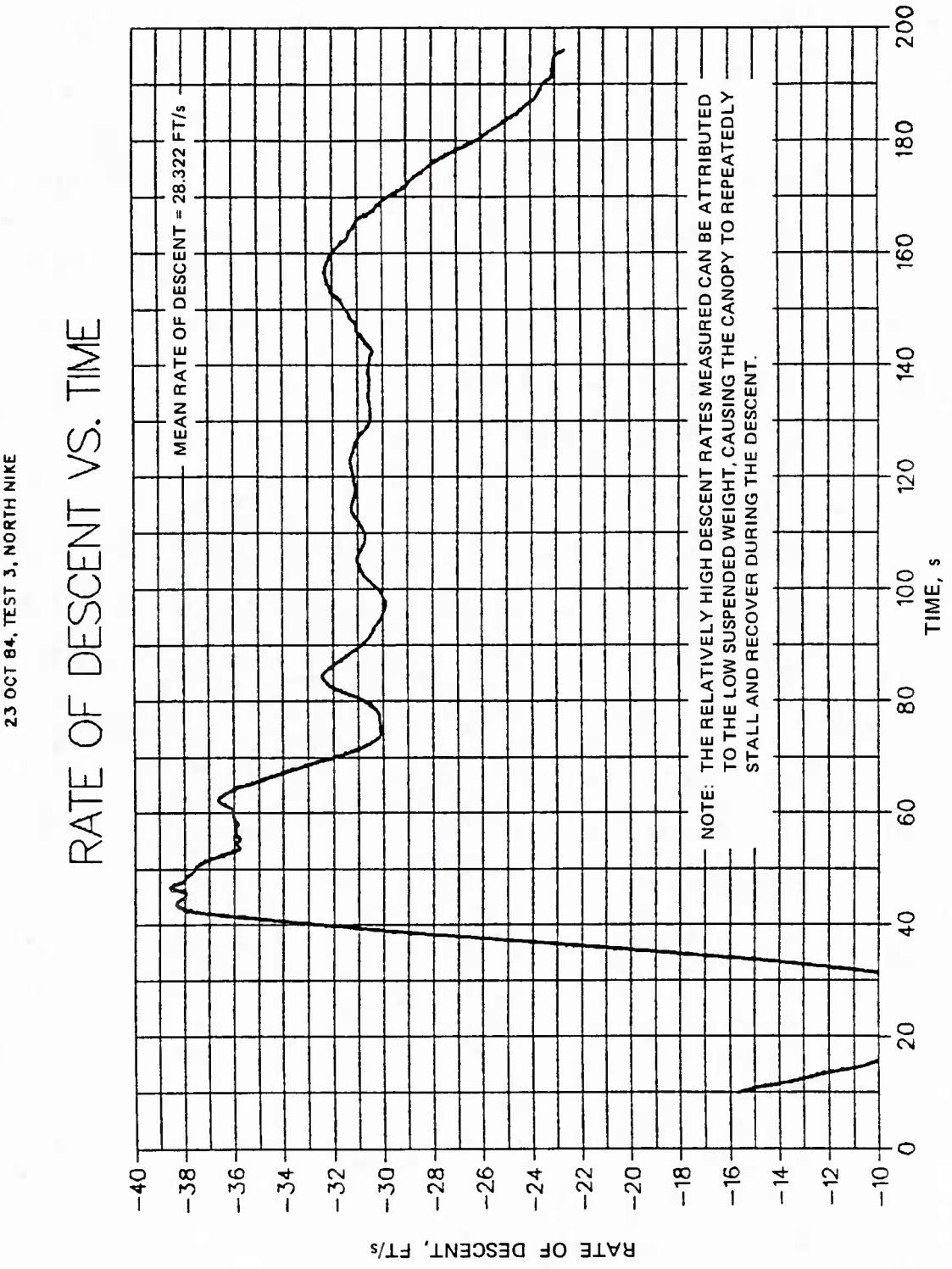

TOTAL RISER FORCE VS. TIME
AGES INFLIGHT EJECTION, 23 OCTOBER 1984
FORCE (LB)
2000
1800
1600
1400
1200
1000
800
600
400
200
0
-200
TIME (SEC)
0
0.5
1
1.5
2
2.5
3
3.5
4

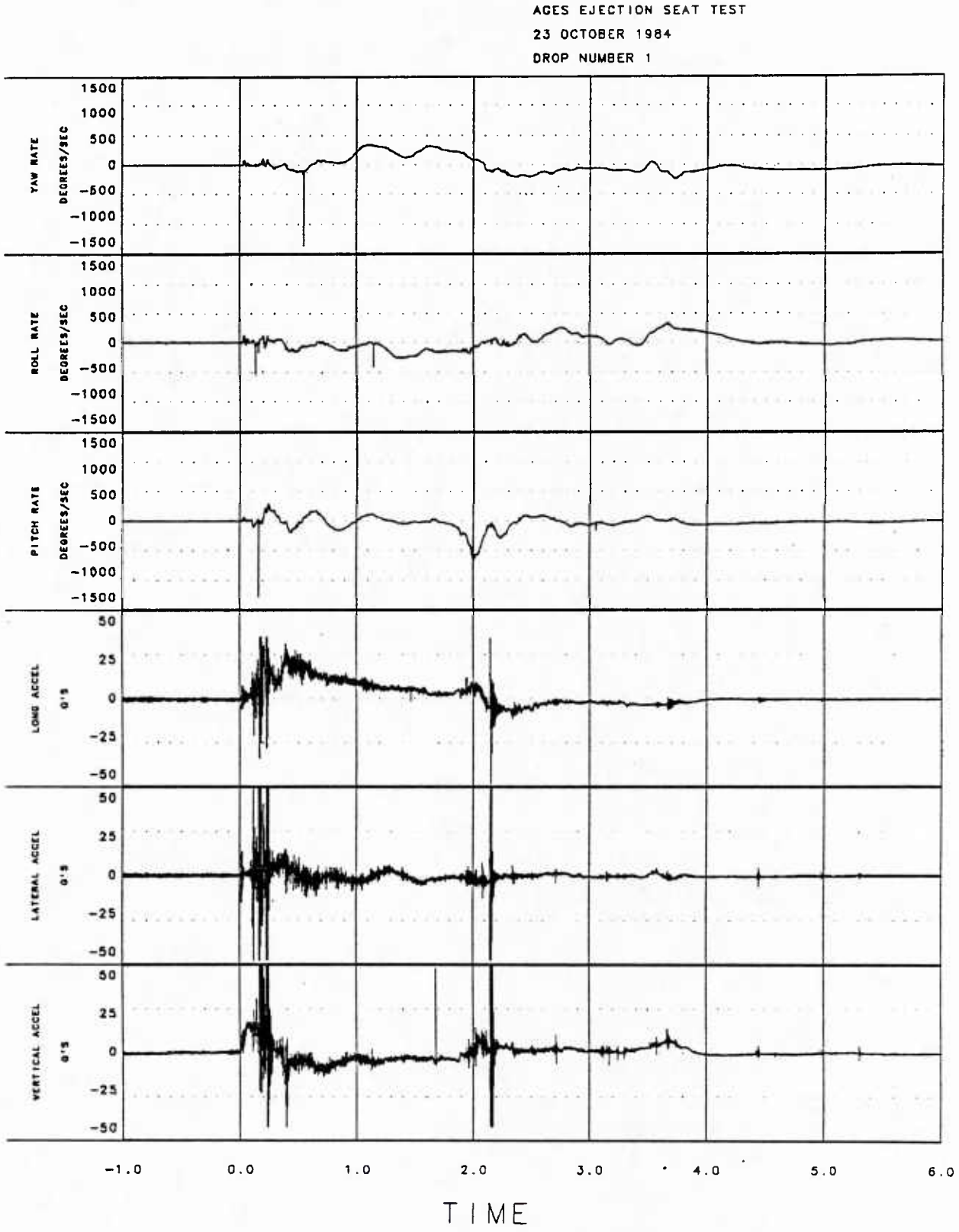
NAVAL WEAPONS CENTER
RANGE DEPARTMENT
DATA BRANCH (CODE 6252)

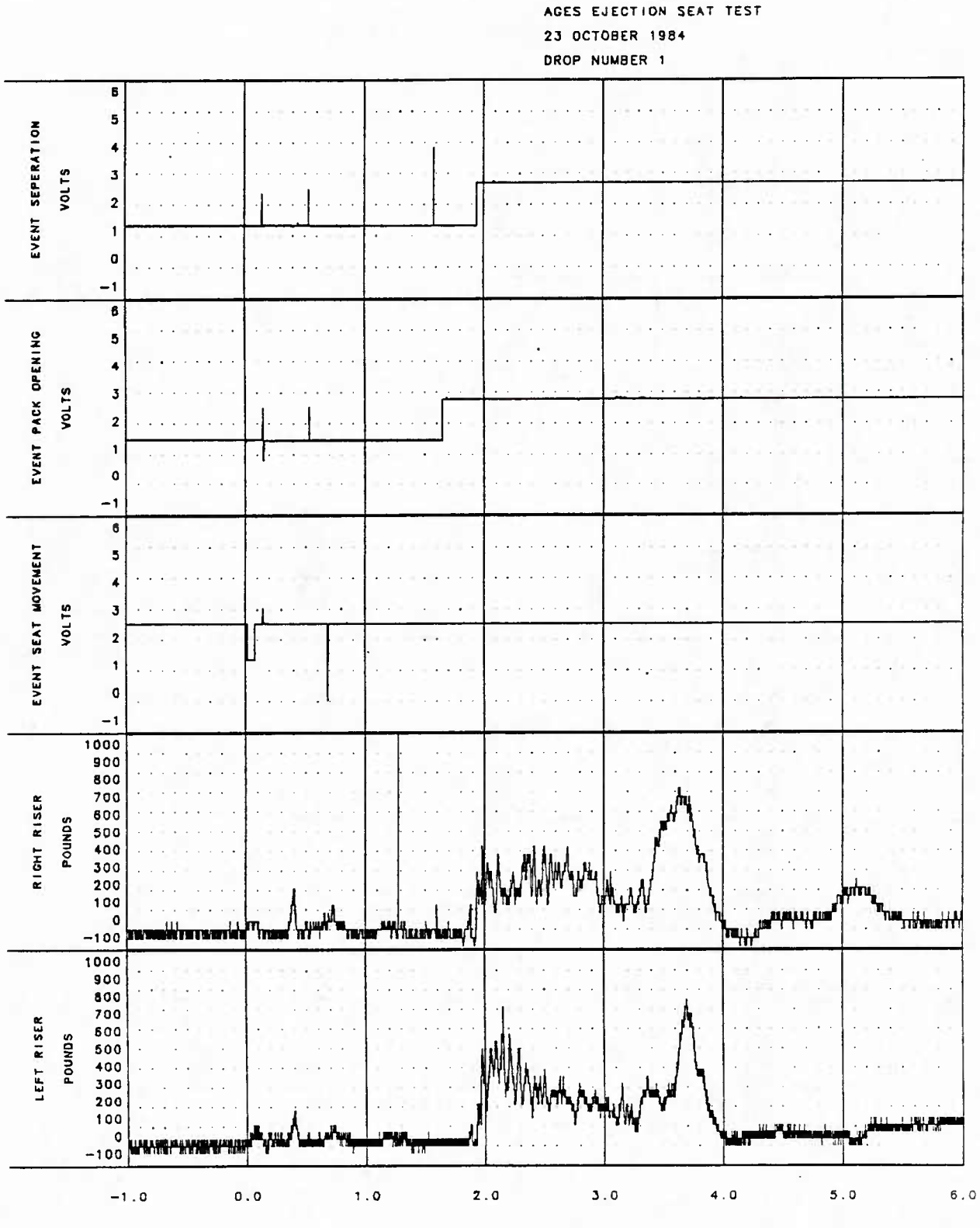
TP 84P431 AGES
TESTED 23 OCT 1984

TABLE OF EVENT TIMES

	EVENT	Film Time Hrs.	Mins.	Seconds	Elapsed Time Seconds
4	Drogue projection	15:	40:	09.411	0.000
6	Catapult separation			09.461	0.050
7	Word release			10.914	1.503
8	Main chute pack open			10.950	1.539
10	Main chute pack extraction			10.968	1.557
11	Line stretch			11.130	1.719
11A	Main chute bag separation			11.166	1.755
12	Seat dummy separation			11.383	1.972
11B	~~Seat~~ MAIN chute leading edge disreef			12.286	2.875
11C	Main chute bottom disreef			12.476	3.065
11D	Main chute slider disreef			12.936	3.525
13	Main chute full open			13.225	3.814
14	Impact (dummy)	15:	43:	01.749	172.338
15	Impact (seat)	15:	44:	02.678	233.267


RATE OF DESCENT VS. TIME
23 OCT 84, TEST 3, NORTH NIKE
MEAN RATE OF DESCENT = 28.322 FT/s
NOTE: THE RELATIVELY HIGH DESCENT RATES MEASURED CAN BE ATTRIBUTED TO THE LOW SUSPENDED WEIGHT, CAUSING THE CANOPY TO REPEATEDLY STALL AND RECOVER DURING THE DESCENT.
RATE OF DESCENT, FT/s
TIME, s
-40
-38
-36
-34
-32
-30
-28
-26
-24
-22
-20
-18
-16
-14
-12
-10
0
20
40
60
80
100
120
140
160
180
200


AGES EJECTION SEAT TEST
23 OCTOBER 1984
DROP NUMBER 1
YAW RATE
DEGREES/SEC
ROLL RATE
DEGREES/SEC
PITCH RATE
DEGREES/SEC
LONG ACCEL
G'S
LATERAL ACCEL
G'S
VERTICAL ACCEL
G'S
1500
1000
500
0
-500
-1000
-1500
50
25
0
-25
-50
-1.0
0.0
1.0
2.0
3.0
4.0
5.0
6.0
TIME


AGES EJECTION SEAT TEST
23 OCTOBER 1984
DROP NUMBER 1
EVENT SEPERATION VOLTS
EVENT PACK OPENING VOLTS
EVENT SEAT MOVEMENT VOLTS
RIGHT RISER POUNDS
LEFT RISER POUNDS
6
5
4
3
2
1
0
-1
1000
900
800
700
600
500
400
300
200
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TIME

INITIAL DIS

7 Naval Air Systems Command
- AIR-310C (1)
- AIR-340B (1)
- AIR-531 (1)
- AIR-5311 (1)
- AIR-5312 (1)
- AIR-723 (2)

2 Chief of Naval Operations
- OP-05H (1)
- OP-098E (1)

2 Chief of Naval Research
- OCNR-440 (1)
- OCNR-441 (1)

1 Commander in Chief, U.S. Pacific Fleet (Code 325)

3 Naval Medical Command
- Code 23 (1)
- Code 231 (2)

2 Naval Medical Research and Development Command, Bethesda (Code 44)

3 Naval Sea Systems Command
- SEA-06Z (1)
- SEA-09B312 (2)

1 Marine Corps Development and Education Command, Quantico

1 Commander, Third Fleet, Pearl Harbor

1 Commander, Seventh Fleet, San Francisco

2 Naval Academy, Annapolis (Director of Research)

6 Naval Aerospace Medical Institute, Pensacola
- Code 032 (1)
- Code 06 (1)
- Code 09 (1)
- Code 095 (2)
- Code 10 (1)

2 Naval Aerospace Medical Research Laboratory, Pensacola (Code 00A1)

4 Naval Air Development Center, Warminster
- Code 60B (2)
- Code 6032 (2)

1 Naval Air Test Center, Patuxent River (Code SY-70)

1 Naval Postgraduate School, Monterey

1 Naval Safety Center, Norfolk (Code 14)

1 Naval War College, Newport

3 Army Aeromedical Research Laboratory, Fort Rucker

3 Army Research and Development Laboratories, Natick
- STRNC-UA (2)
- Technical Library (1)

1 John F. Kennedy Special Warfare Center, Fort Bragg (ATXA-BDT)

1 Yuma Proving Grounds, Yuma (ATSU-CD-ML)

2 Air Force Flight Test Center, Edwards Air Force Base (ENAD)

1 Air Force Intelligence Service, Bolling Air Force Base (AFIS/INTAW, Maj. R. Lecklider)

1 Air Force Medical Research Laboratory, Wright-Patterson Air Force Base (Human Engineering Division)

12 Defense Technical Information Center, Alexandria

1 Federal Aviation Administration (Standard Division)

2 Library of Congress (Science and Technology Division)